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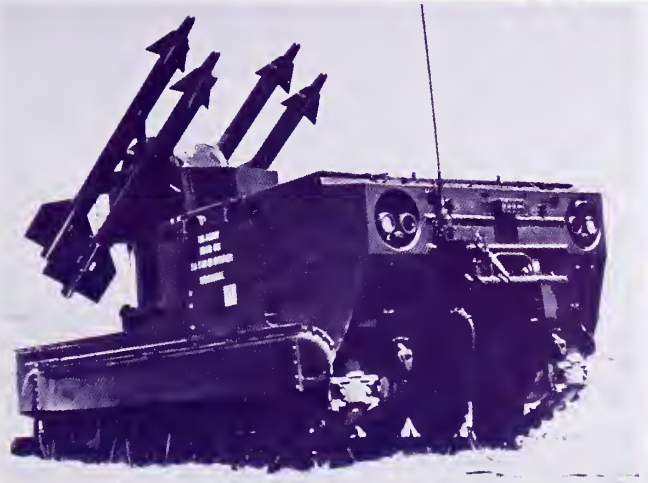

SPEAKING ON . . .

Defense Guidelines for Control of Technology Exports

Dr. Ellen Frost

Dr. Ruth Davis

In view of the recent international meeting on goals and problems of technology transfer held in Estoril, Portugal (see report on page 4), an Oct. 27, 1977, presentation to the Subcommittee on International Economic Policy and Trade, United States House of Representatives is considered important to an understanding of the safeguards imposed by the Department of Defense. The presentation was made by Deputy Assistant Secretary of Defense (ISA) Dr. Ellen Frost.

Mr. chairman and members of the subcommittee, I welcome the opportunity to appear before this subcommittee to describe the guidelines under which the Department of Defense currently is carrying out its role in the control of technology exports, the issues they raise, and the Department's specific plans for further action in this area.

With me is my colleague, Dr. Ruth Davis, Deputy Director of Defense Research and Engineering (Research and Advanced Technology), who is responsible for the technical aspects of these subjects.

Let me take a moment or two at the outset to outline the system of export controls established by the U.S. and its major allies to restrict the flow to the Communist world of equipment and technology of military significance.

U.S. controls originated in World War II and were codified in the Export Control Act of 1949. This act was replaced by the Export Administration Act of 1969, under which we are currently operating. It is implemented through a commodity control list compiled by the Department of Commerce and a licensing system administered by that Department.

The policy statements contained in the Export Administration Act illustrate the difficulties of drawing up hard and fast rules in this field. Section 3(1), for example, states that it is the policy of the United States both to encourage trade with most nations and "to restrict the export of goods and technology which would make a significanct contribution to the military potential of any other nation or nations which would prove detrimental to the national security of the United States."

Section 3(2) includes a statement that it is U.S. policy to use export controls to the extent necessary to further significantly the foreign policy of the United States. I am by no means questioning this multi-purpose policy framework; I cite it merely to sketch the broad setting of export control decisions and the complex issues which they pose.

Another dimension of export controls lies in our relationships with our Allies. Both U.S. law and long-standing U.S. policy mandate the maximum possible degree of cooperation with our Allies in this area.

The Allied strategic controls began in 1949 with the establishment of the International Coordinating Committee, since known as COCOM, composed of the NATO Allies less Iceland plus Japan with delegations in Paris sitting in permanent session. Each nation agrees to coordinate its export controls with that of the other members.

Accordingly, there is an agreed list of embargoed items which no COCOM country will export to a Communist country unless it obtains the approval of the other members. This list is reviewed and updated in a formal series of negotiations which we and our COCOM partners undertake normally every three years.

In preparation for this list review, we established a number of Technical Task Groups made up of technical experts from several departments and agencies to review the entire embargo list and recommend deletions, modifications or additions to it.

Since the next review is scheduled for October 1978, these groups are now being formed and a new set of precepts, keyed to the current emphasis on technology controls, is being provided for their guidance. The results of the work of these technical task groups will go a long way to determining how much the list of end products under embargo will be reduced.

The Department of State is responsible for administering U.S. participation in COCOM and supplies the permanent delegate for the United States as well as the office space and conference facility for the organization in Paris. On both U.S. and COCOM controls there is extensive interdepartmental coordination among the Departments of State, Defense and Commerce.

The Export Administration Act assigns a special role to the Secretary of Defense. Specifically, it requires him to make an assessment of items, both goods and technology, that are of military significance to controlled countries. These are the Communist countries with the addition, under a 1974 amendment, of Yugoslavia.

Amendments enacted in 1977 require that, beginning in 1979, U.S. policy toward individual countries shall be determined by a number of variables, and not merely by a country's Communist or non-Communist status.

The Act further empowers the Secretary of Defense to determine which U.S. export cases he wants to review. He is then required to recommend approval of such cases, to register an objection with conditions, or to indicate an outright objection.

Only the President can overrule the Secretary of Defense if he registers an objection. In such an instance, the President must report his actions to the Congress, giving the position of the Secretary of Defense and the reasons for overruling it.

So much for the procedures. With or without these special measures, we in the Department of Defense have long been aware of the importance to our security of advanced technology. In 1974 we asked the Defense Science Board to take a fresh look at our system for controlling technology exports. Its report, completed in early 1976, is known as the Bucy Report for its chairman, J. Fred Bucy of Texas Instruments.

Although the report made a number of recommendations, its chief finding was that the control of exports of design and manufacturing know-how is absolutely vital to the maintenance of U.S. technological superiority and continued comparative qualitative superiority in deployed weaponry.

Since last year the Department of Defense, under the leadership of the Director of Defense Research and Engineering (DDR&E), has been engaged in a far-reaching effort to put the Bucy recommendations into practice. These efforts focus on (1) the identification of critical technologies and products, (2) the assessment of the active mechanisms of technology transfer, (3) the development of simplified criteria for product control, and (4) the feasibility and desirability of new administrative procedures or legislation for streamlining the existing export control system.

A major portion of DDR&E's efforts during the past year related to the implementation of the Bucy Report has been preparing an initial list of "critical technologies."

This term is defined as know-how whose acquisition by a potential adversary could make a significant contribution to that country's military potential, which would prove detrimental to the United States. The effort to identify these technologies has involved contract support from various groups and active participation by the technical community within industry, Defense and elsewhere in the government.

The ultimate objective of such a list is to provide improved guidance to the Commerce and State Departments in their preparation of export control lists and licensing procedures.

Several steps have been taken within Defense to rationalize and improve administrative procedures and streamline export control operations. A major step is that of placing greater responsibility on the Director of Defense Research and Engineering for the technical aspects of Defense recommendations.

A number of technical tasks remain to be completed. Among them is that of identifying on the one hand so-called "keystone equipment," defined as equipment that completes a process line and allows it to be fully utilized. Its strategic significance derives from its uniqueness when compared to the other process and test equipment required to produce a strategic product. Computer controlled process, inspection, and test equipment is often an example. Such equipment must be retained under control.

On the other hand, we must identify products which can be dropped from the embargo list. This task is intrinsically bound up with the identification of critical technologies and keystone equipment. Only when we decide what is truly significant can we conclude, by elimination, what is not so important. Thus the two processes must advance simultaneously. Both are now going forward as we prepare for next year's COCOM embargo list review. We believe these changes will assist us in meeting our responsibilities in this area.

Yet another initiative in this area comes from the White House. As you know, the President has directed a study, which goes well beyond the scope of the Bucy Report, of the whole question of export controls over technology. That study is now under way and its conclusions are, of

(Continued on page 15)

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ABOUT THE COVER . . .

When MIRADCOM and MIRCOM were created in January 1977 from resources of MICOM, management of research, development, testing and initial acquisition of U.S. Army missiles and rockets went to MIRADCOM. MIRCOM was assigned logistic support and operational readiness missions for deployed missiles and rocket systems. Pictured are some of the systems in various stages of RD&A, with responsibilities divided between both commands. From top, left, are the U.S. Roland, TOW missile system, Hawk missiles, Chaparral, and the General Support Rocket System. Both commands are major subordinate commands of the U.S. Army Materiel Development and Readiness Command (DARCOM) Alexandria, VA.

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FEATURES

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Selective Scanner

Army Selects German 120mm Gun for XM1 Tank

Should the Federal Republic of Germany's 120mm smooth-bore gun system go into U.S. development and testing as the potential main armament for the U.S. XM1 tank—for use in the 1984 time frame and possibly extending to year 2,000—to enhance interoperability of future tanks within NATO?

Members of Congress face a decision on that complex question, following a recommendation by Secretary of the Army Clifford L. Alexander Jr., with the concurrence of Secretary of Defense Harold Brown, favoring such action.

Selection of the German gun system was made in competitive consideration of the British rifled-bore 120mm and the U.S. 105mm gun systems.

Secretary Alexander said primary reasons for the decision include confidence in the U.S. 105mm gun with improved ammunition to serve current and near-term requirements. "Inherent power" of the larger German gun, he added, will provide a significant advantage against more advanced armors.

Long-term weapon commonality within NATO is increased by U.S. adoption of the German weapon rather than the British gun, he said, explaining that both systems are "basically similar in performance and potential."

However, he added, the German tank fleet is larger and there is apparently a lack of complete interoperability of the British gun. (Germany plans to use its 120mm gun on its Leopard II tank, which was competitively evaluated for possible U.S. production with the XM1.)

Provided Congress and the President approve selection of the German gun, some design modifications will be needed to reduce the cost of production in the U.S. and to take advantage of certain ammunition advances, Alexander said.

To achieve the goal of fielding the XM1 tank as rapidly as possible, the U.S. Army plans to continue to use the 105mm gun until installation of the German gun system is judged practicable. The initial acquisition requirement is for 3,300 XM1s, and plans provide for eventual procurement of as many as 3,700 more.

In response to a query at a press conference, Secretary Alexander said he had no basis for predicting how many XM1s will carry the 105mm, nor whether plans call for 120mm retrofitting of a set number of XM1s in service.

If Congress approves U.S. production of the German 120mm gun, fabrication will be done at the Army's Watervliet (NY) Arsenal.

ASA (RDA) Views XM-1 Armament Contenders

Assistant Secretary of the Army (Research, Development, and Acquisition) Dr. Percy Pierre and other high-ranking U.S. and foreign nation representatives attended a demonstration of three rival systems for arming the U.S. Army XM1 tank as part of the evaluation for a standardized weapon.

Dr. Pierre welcomed the participants to the demonstration at Aberdeen (MD) Proving Ground. Briefings were given by GEN Sir Hugh Beach, master general of Ordnance, on the British 120mm rifled gun system, and MG Bennett L. Lewis, commander, Armament R&D Command, on the U.S. 105mm rifled gun with improved ammunition.

Ministerialdirigent Diplomingenieur Peter Runge, head of the Department for Weapons and Ammunition, made the presentation on the German 120mm smoothbore gun system developed for the prototype Leopard 2 tank.

The XM1 tank turret is designed to accommodate any of the three guns, each of which was fired at identical armor targets. Evaluation observers examined each weapon and the effects on targets.

Americans involved in the decision-making process from Congress, the Office of the Secretary of Defense and the Department of the Army attended the demonstration. French observers attended by invitation of the nations involved in the competitive gun systems.

Conferees Examine Army's International Programs

Current and future plans for achieving total integration of Army international programs, to meet standardization and interoperability requirements, themed a recent conference at HQ U.S. Army Materiel Development and Readiness Command, Alexandria, VA.

Importance of the conference was evidenced by attendance of Under Secretary of the Army Dr. Walter B. LaBerge; Assistant Secretary of the Army for Research, Development, and Acquisition Dr. Percy A. Pierre; Army Vice Chief of Staff GEN Walter T. Kerwin; DARCOM Commander GEN John R. Guthrie; Commander U.S. Army Training and Doctrine GEN Donn A. Starry; and

Deputy Chief of Staff for Operations and Plans LTG E.C. Meyer; Deputy Chief of Staff for Research, Development, and Acquisition LTG Donald R. Keith; Deputy Chief of Staff for Logistics LTG Eivind H. Johansen; Comptroller of the Army LTG Richard L. West; Deputy Commander in Chief U.S. Army Europe/Seventh Army LTG Charles J. Simmons; and Deputy Advisor to the Secretary of Defense for NATO Affairs LTG Kenneth B. Cooper.

Topics and chairmen of five working group discussions were: *Combat Developments/Requirements*, MG William R. Richardson, director of Requirements, ODCSOPS; *Materiel Acquisition*, MG Philip R. Feir, assistant DCSRDA and assistant DCSRDA (International Programs); *Security Assistance/Foreign Military Sales*, MG Bates C. Burnell, assistant DCS for Logistics (Security Assistance); *Testing of Foreign Equipment*, MG Julius W. Becton Jr., commander, U.S. Army Operational Test and Evaluation Agency; and *Logistics*, MG Emil L. Konopnicki, director of Readiness, HQ DARCOM.

U.S. Army Materiel Development and Readiness Command Assistant Deputy for International R&D Bryant R. Dunetz and chief, Department of the Army International Rationalization Office BG Samuel G. Cockerham served as over-all conference coordinators.

One of the primary results of the meeting was agreement for implementation of a Department of the Army Rationalization/Standardization/Interoperability Master Plan (scheduled for March 1978).

Contract Believed Largest Ever to Minority Firm

Award of a $3.473 million contract for research, development and technical service work on the U.S. Air Force F-16 multi-purpose aircraft, announced recently by the Department of Defense, is believed to be the largest DoD contract granted to a minority-owned firm.

Initially placed with the Small Business Administration under Section 8(a) of the Small Business Act, the contract was awarded to Technology Development Corp. of Sunnyvale, CA. Dr. Frank S. Greene, a black PhD, is president of

the two-thirds minority-owned firm.

Deputy Secretary of Defense Charles W. Duncan and Dr. Greene were present at signing ceremonies in the Pentagon. Duncan is chairman, Procurement Policy Committee, Interagency Council for Minority Business Enterprise.

The contract reflects continuing DoD efforts to achieve President Carter's goal of doubling purchase of goods and services from minority-owned firms through direct and indirect procurement during the next two fiscal years.

USACSC May Relocate Pacific Support Group

Relocation of most functions of the U.S. Army Computer Systems Command Support Group, Pacific, from Fort Shafter, HI, to the USACSC Group at Fort Lee, VA, is pending final decision following a public comment period announced by Secretary of the Army Clifford L. Alexander.

Functions affected if the preferred plan is adopted are linked to development, extension and maintenance of the Standing Army Intermediate Level Systems. SAILS would locate with the U.S. Army Logistics Center, Fort Lee, VA, where USALC provides guidance for all Army logistics systems including aid to multicommand computer networks.

Continued customer assistance to Army users at Fort Shafter would be provided by a reduced force of 11 military and 25 civilian personnel. About the same number of civilians, it is estimated, would take advantage of transfer rights to Fort Lee and four more would go to USACSC Headquarters at Fort Belvoir, VA.

USAMMCS Assumes Calibration Training Mission

Training and combat development responsibility for requirements in the Army's calibration mission was transferred recently from the Ordnance and Chemical Center and School, Aberdeen (MD) Proving Ground to the Missile and Munitions Center and School, Redstone Arsenal, AL.

Directed by the U.S. Army Training and Doctrine Command, the change centralizes Army calibration activities.

Calibration doctrine, field manuals, studies, along with development, test and evaluation of calibration materiel and other related functions, are assigned to the Directorate of Combat Developments.

The Directorate of Training Developments will monitor calibration specialists and technicians conducted at Lowry Air Force Base under a tri-service agreement; also, nonresident training developments and publication of manuals and soldier skill qualification tests.

Army Conducts JAWS Phase II at Fort Liggett

Nine AH–1 Cobra helicopters from Fort Hood, TX, and five A–10 jets from Nellis Air Force Base, NV, converged recently over Fort Hunter Liggett, CA, to counter enemy armor in simulation of a high-threat environment.

The mock battle was conducted under Phase II of field exercise JAWS (Joint Attack Weapons Systems) to determine the number of aircraft and methods best suited for combat readiness in a high-threat variable situation. The theoretical tactics were developed at Fort Benning, GA.

Near real combat conditions are provided in a simulated environment at the Hunter Liggett field laboratory, about 90 miles south of Monterey. Smoke, blank ammunition and recorded sounds of a battle provide realism.

Aircraft and threat locations are recorded by a Range Measuring System (RMS) that transmits data through a series of radio play for instant reading and recording by a central computer. All aircraft and armored vehicles are equipped with special electronic devices.

Foxhole Covers to Become Standard Issue Items

Plans to provide foxhole covers, developed in 1970 by the U.S. Army Mobility Equipment Research and Development Command, as standard issue items for combat personnel operating forward of brigade rear boundaries, were announced recently by the Department of the Army.

Tactical survival studies conducted by the U.S. Army Engineer School stressed that the highly mobile modern battlefield demands timely positioning of combat forces to achieve maximum effectiveness.

Today's soldier, the report states, must be able to dig in quickly, fight, and move out while under hostile fire. Foxhole covers will hopefully eliminate time-consuming work of hardening (making less vulnerable) fighting positions.

Constructed of woven dacron fabric, the cover weighs one pound and 10 ounces and is six feet by five feet and four inches. Tubular sections along each side can be filled with dirt and anchored in shallow ditches on all sides.

When topped by 18 inches of soil, the cover is capable of withstanding effects of shrapnel, blasts and other debris. Two or more covers can be joined by use of snap fasteners located on each side of the cover.

Contract Calls for 83 Additional Cobra Helicopters

Purchase of 83 additional units of the AH–1S improved Cobra helicopter at a cost of $70,758,833 under provisions of a contract option was announced Dec. 21, with deliveries scheduled during 1979-80.

Department of the Army plans call for acquisition of 297 production models of the AH–1S and the latest purchase increases procurement to more than 75 percent of the total order. Deliveries began in March 1977.

Equipped with the TOW missile system, and incorporating other operational and maintenance improvements, the AH–1S is under administration of the U.S. Army Troop Support and Aviation Materiel Readiness Command, St. Louis, MO, during the acquisition program.

Federal Civilian Employment Statistics Released

The Civil Service Commission reported Dec. 22 that federal civilian employment decreased by 1,424 during October to a total of 2,839,687.

As of Oct. 1, employment in the Department of Energy totaled 19,647, with 19,407 transferred from the Energy Research and Development Administration, Federal Energy Administration, Federal Power Commission, and from offices within the Department of the Interior. Other agencies transferring employees to the Department of Energy are Commerce, Navy, Interstate Commerce Commission.

Executive Branch Employment totaled 2,788,065 (−992). This included 2,552,427 (−6,887) in full-time positions and 235, 638 (+5,895) in non-full-time positions. Other agencies with sizeable changes included: U.S. Postal Service (−5,852); Veterans Administration (+1,443); Agriculture (−1,277); and Tennessee Valley Authority (+1,122).

ACC Reroutes Fort Buckner AUTODIN Traffic

Reduction of American forces in the Pacific area, along with the continuous review of communications-electronics assets and requirements throughout the world, has led to an Army decision to place the AUTODIN switch at Fort Buckner, Okinawa, in a caretaker status, Jan. 15, 1978.

U.S. Army Communications Command (ACC) officials announced that traffic now passing through the Fort Buckner facility will be rerouted through other facilities in the Pacific area, with no degradation of service to customers.

R&D News... ERADCOM, CORADCOM, CERCOM Activated

U.S. Army actions pending for many months in consideration of available options—with the goal of using most advantageously existing facilities and minimizing personnel impact—became effective Jan. 1 with activation of ERADCOM, CORADCOM and CERCOM as major subcommands of DARCOM.

ERADCOM denotes the Electronics Research and Development Command, headquartered in facilities of the Harry Diamond Laboratories, one of the nation's most modern research plants, at Adelphi, MD. CORADCOM stands for the Communications R&D Command and CERCOM is the short term for the Communications and Electronics Materiel Readiness Command, both headquartered at Fort Monmouth N.J.

U.S. Army Materiel Development and Readiness Command leader GEN John R. Guthrie attended Jan. 3 ceremonies at Adelphi and Fort Monmouth, NJ, long the headquarters of the Army Electronics Command, disestablished with the activation of ERADCOM, CORADCOM and CERCOM.

Establishment of the new commands completes the reorganization of DARCOM major commands in implementation of recommendations of numerous study groups appointed to consider findings and proposals of the former Army Materiel Acquisition Review Committee.

ERADCOM is commanded by MG Charles D. Daniel, CERCOM by MG John K. Stoner Jr. and CORADCOM by MG Hillman Dickinson, all of whom have been heading the provisional organizations of the new commands.

Personnel impact of the realignments involves about 6,800 civilian and military personnel of the former Electronics Command at Fort Monmouth; also, about 1,200 civilian and military workers at Adelphi, MD; 550 at White Sands Missile Range, NM; and 550 at Fort Belvoir, VA. Roughly 3,950 employes are reassigned to CERCOM, 1,200 to CORADCOM and 1,000 to ERADCOM elements that will remain at Fort Monmouth. About 660 military personnel are with the new commands.

CORADCOM operating elements will remain at Fort Monmouth, including most of the communications-related Project Manager Offices, the Communications Agency—Army project manager for development of Department of Defense Satellite Communications System ground terminals.

CERCOM includes all of the former ECOM logistics elements, which will remain at Fort Monmouth, Sacramento Army Depot, CA, and Fort Huachuca, AZ.

CERCOM is charged with follow-on acquisition and materiel readiness for communications and electronics products that have been fielded or will be transitioned from ERADCOM, CORADCOM, and the Aviation R&D Command (AVRADCOM).

CORADCOM is responsible for research, development and first production acquisition, along with initial fielding, of communications, tactical data, and command control systems.

During its 15-year history, ECOM had responsibility for total life-cycle management of Army electronic materiel, encompassing research, development, procurement, production, distribution, maintenance and final disposal.

ERADCOM assumes responsibility for some major elements that will remain at Fort Monmouth, namely the Electronics Technology and Devices Laboratory, the Electronic Warfare Laboratory, and the non-laser portions of the Combat Surveillance and Target Acquisition Laboratory.

Operational also as ERADCOM elements are the Atmospheric Sciences Laboratory at White Sands (NM) Missile Range, which will absorb certain related atmospheric sciences activities that were performed at Fort Monmouth, and the Office of Missile Warfare, both at White Sands (NM) Missile Range.

Other ERADCOM elements are the Harry Diamond Laboratories, the Night Vision and Electro-Optics Laboratory at Fort Belvoir, VA, and the Signals Warfare Laboratory, which currently has activities at Arlington Hall Station, VA, and Vint Hill Farms, VA. SWL efforts were transferred to ERADCOM to consolidate R&D programs.

The command also performs certain functions formerly assigned to the U.S. Army Intelligence and Security Command (INSCOM), and some electronics R&D activities of the former ECOM (exclusive of communications and automatic data processing activities).

Four project managers of major weapons systems development assigned to ERADCOM are responsible for mortar and artillery-locating radars (Firefinder); battlefield sensors (REMBASS); aerial ground target acquisition system (SOTAS); and signals intelligence and electronic warfare sensors (Control and Analysis Centers—CAC).

ERADCOM is the Army's principal developer of electronic materiel, including electronic warfare and signal intelligence, fuzing, atmospheric sciences, radar and target acquisition, night vision systems, lasers and electro-optics, fluidics, and nuclear weapons effects.

The Atmospheric Sciences Laboratory (ASL) is concerned with establishing an atmospheric/environmental technology base for electro-optical military weapons systems, meteorological equipment, and intelligence systems.

This ASL mission focuses on enhancing combat and strategic operations including ground and air-mobile capabilities; site defense; high-energy lasers; night observation; target acquisition; and nuclear, biological and chemical operations.

The ASL also is working on improved techniques and automated meteorological data collection, atmospheric sensors, and modeling of upper atmospheric transmittance. The goal is to provide a "real-time" weather picture over battlefield areas.

Combat Surveillance and Target Acquisition Laboratory expertise includes radar, photography, remote sensing, acoustics, nuclear radiation detection and measurement, data links, and

Conferees Probe Technology Transfer Barriers

Goals and problems of technology transfer were considered in Estoril, Portugal, Nov. 7-11, at a conference attended by high-ranking representatives of U.S. Government, industry and the academic community.

Heading the delegation was Under Secretary of the Army Dr. Walter LaBerge, former U.S. Assistant Secretary General for Defense Support, NATO. In his keynote address, Dr. LaBerge stressed the vital importance of technology transfer to the NATO readiness posture.

The U.S. Departments of the Army, Navy and Air Force and the North Atlantic Treaty Organization cosponsored the conference, attended by about 125 representatives from NATO countries and Japan. The purpose was to find ways to encourage the more industrially developed countries to provide technological know-how to less developed nations.

The U.S. delegation included representatives from NATO staffs; Department of State; Department of Health, Education and Welfare; Internal Revenue Service; General Accounting Office; National Institutes of Health; National Science Foundation; U.S. House of Representatives staffs; U.S. Mission to UNESCO; and U.S. Chamber of Commerce.

Attending for the U.S. Army were LTC Gary R. Hyde, Office of the Under Secretary of the Army; Dr. Charles H. Church, COL Joseph E. Wagner, Dr. Robert J. Heaston, Albert Birra, and Harold Davidson, all with the Office of the Deputy Chief of Staff for Research, Development, and Acquisition, HQ DA; Dr. Ferdinand DePercin, Office of the Chief of Engineers; COL J. D. Marshal, Letterman Army Institute of Research; COL Lothrop Mittenthal and LTC J. F. Colby, U.S. Army Research and Standardization Group (Europe); Edward J. Kolb, Lawrence Sturdivan, MAJ J. D. Elliott and Joseph Lindwarm, HQ U.S. Army Materiel Development and Readiness Command; C. E. Lanham, Harry Diamond Laboratories, and LTC R. R. Leonard, Missile Research and Development Command.

University representation was provided by attendees from Wake Forest University, Georgia Institute of Technology, University of Maryland and the University of Colorado. Key U.S. industries were represented by EXXON Research and others who sent specialists from their foreign affiliates.

Sessions were conducted in two forms: Prepared main tasks, followed by questions from the audience; and panel discussions opened by short remarks from each member, followed by general questioning and discussion.

Discussions ranged from the transfer of very high technology, such as military systems, to the transfer of commercial technology and products. A question that ran through all of the discussions was: What relative advantage exists for the recipient or for the donor?

In general, it was agreed that for the recipient country the advantage could be the balance of trade, a policy of local procurement, or even a need to up-grade technology management skills. For the donor country, the advantage would rest principally in income through licensing, and by providing greater Free World security by economic and military strengthening of these countries.

Barriers to technology transfer were noted as being primarily patent policy, particularly that of the United States in contrast to policies of the European economic community; policies governing critical technology export limits; language differences including English measurement system versus metric, and the ability of a recipient nation's technologically trained personnel to absorb and apply the new knowledge.

LTC J. F. Colby, U.S. Army Research and Standardization Group (Europe), participated in the panel session on Military Standardization. MAJ T. G. Ward, U.S. Roland Project Office, was a panelist on te session discussing the governing factors affecting the decision to import technology.

identification of friend, foe or neutral (IFFN). Emphasis is on fieldworthy, affordable, reliable, maintainable systems having improved life-cycle expectancy.

Electronics Technology and Devices Laboratory activities are oriented to eliminating barriers that constrain performance of next-generation electronics devices. Ongoing work is conducted in areas of high-speed, low- power, large-scale integrated circuits, engineering refinements, lost-cost microwave and millimeter devices, and practical, lightweight, rugged fiber-optic tactical cable systems.

Electronics Warfare Laboratory functions include applied research and development in the areas of intercept, direction finding, signal analysis, jamming, deception, signal intelligence, acoustic intelligence, self-protection, agent equipment security, counterintelligence, vulnerability, countermeasures and counter-countermeasures.

Signals Warfare Laboratory responsibilities include R&D, acquisition and integration of electronic equipment in support of signal intelligence, electronic warfare, and signal security missions. Expertise is in development of equipment that will allow for jamming, deception or information to destroy hostile electronics.

Night Vision and Electro-Optics Laboratory activities are concerned with image intensification, far infrared, radiation sources, visionics, lower-cost all-weather vision systems and electro-optical low-energy lasers.

Harry Diamond Laboratories perform as the principal developer of electronic projectile fuzing, and as the Army program manager for fluidics and nuclear weapons effects. The mission also involves nuclear survivability (hardening), radar security systems, instrumentation, training devices, and analog signal processing.

WSMR Scientist Gives Report On 5-Year Fungi Effects Study

A microbial bank of 250 species of fungi linked to biodeterioration of U.S. Army materiel has been established as part of a 5-year study by Oscar H. Calderon at White Sands (NM) Missile Range.

Highlights of the study were reported at the recent second International Mycological Congress. Calderon used slides to show that microorganisms actually produce "living bridges" across electronic components, causing malfunctions. Some organisms produce organic acids that corrode metals, thereby accelerating deterioration.

Calderon, a senior microbiologist, has isolated 12 different fungi from tropic and desert soils that have impacted on Army equipment. He also has collected data on time required for fungal spores to germinate and double weight.

"Military Standard Fungi" exhibited no measurable decomposition when subjected to a controlled environment, he reported, but decompose in measurable quantities in actual field tests. Test fungi used in the laboratory, he reported, were not representative of those in the desert or tropics.

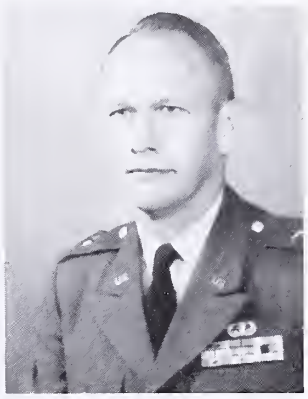
Standard fungi were not strong decomposers in the tests compared with desert and tropic specimens which grow larger amounts of carbohydrates and produce more organic acid.

Part of the 5-year study was conducted at New Mexico State University under direction of the late Dr. Eugene E. Staffeldt, and at the University of Texas (El Paso) under direction of the late Dr. Larry P. Jones.

Jones Shares Annual Army PM Honors With Ragano

Sharing the spotlight with BG Frank P. Ragano for U.S. Army Project Manager of the Year honors for exceptional achievement is BG John G. Jones, whose selection was announced too late to be included in our October-November edition of the *Army Research and Development Newsmagazine.*

BG Ragano was honored by presentation of the award at the eighth annual U.S. Army Materiel Development and Readiness Command Project Managers Conference as PM for the Roland weapon system. BG Jones became the first winner of an identical award to be selected outside of DARCOM, in recognition of his work on the Ballistic Missile Defense Program.



Simultaneously he served as commander of the BMD Systems Command, thus becoming the first man to hold concurrently the two positions, involving also duty as commander, Kwajalein National Missile Range in the Pacific.

Assigned currently as deputy chief of staff for Operations, NATO Allied Forces, Central Europe, BG Jones served as military assistant to the Deputy Secretary of Defense prior to his tour of duty with BMD Systems Command.

Other key assignments in recent years have included assistant for Combat Materiel, Office of the Assistant Secretary of the Army for Research and Development; chief, Programs, Plans and Operations, Army Main Battle Tank Program.

'Project Successor' Forms Standardized NATO Programs

A standardization link of NATO weapon programs was formed by Project Successor when a 2½-year German-U.S. study evaluating the Army's Patriot for a European defense role, particularly in Germany, was concluded recently at the U.S. Army Missile R&D Command (MIRADCOM), Redstone Arsenal, AL.

During the project, the 25-man study team used Computer Model Como III to conduct war games simulating large-scale, force-on-force battles. The computer permitted technical people to speak the same language and marked the first time the system was used in a study of this magnitude.

Study director Jim Jernigan, an electronics research engineer in MIRADCOM's Advanced Systems Concepts Office, said ". . . the mountains of data obtained during the 2½-year study here will play a crucial role in the NATO decision. NATO already has established two multinational groups considering Patriot as a replacement in NATO for both the Hawk and Nike Hercules missiles."

In addition to the U.S. and Germany, six other NATO countries are conducting follow-on studies of Project Successor to evaluate the future role of Patriot, which is project managed in Huntsville Research Park, AL, under MG Oliver D. Street III.

Patriot is designed to be the cornerstone of field Army air defense against medium- to high-altitude targets in the 1980s and beyond. The highly mobile, all-weather Patriot is the only air defense weapon of its kind, and capabilities, under development in the Free World.

Headed by MAJ Peter Diehl, a 2-man German team has remained at the Patriot Project Office for initial staffing of a German liaison office. The Germans are refining military requirements and reviewing their acquisition process, including procurement (potentially) of the Patriot system.

HSTRU Expected to Reduce Equipment Downtime

Development of a Hydraulic System Test and Repair Unit (HSTRU) that permits rapid on-site maintenance of a broad range of systems using hydraulic power controls is announced by the U.S. Army Mobility Equipment Research and Development Command (MERADCOM), Fort Belvoir, VA.

Acquisition of 168 units as an initial buy, with an option to purchase an additional 200, at a unit cost of $17,500 on a total buy, is provided by a contract awarded by MERADCOM to American Development Corp., Charleston, SC. Units will be mounted on a 3/4-ton trailer.

Towable cross-country or deployable by helicopter, the 3,000-pound unit has an 8 x 4 x 3½-foot watertight enclosure to protect equipment, including hose cutting and skiving tools, multi-range pressure gauge, hose coupling assembler, and a tube cutting, deburring and bending set.

Additional equipment includes a hydraulic system tester for temperature, flow and pressure, cleaning and flushing systems, and other items normally required by a mechanic in the field. Field generators and contact maintenance trucks (or commercial power sources) will be used to meet the HSTRU's requirement for 3.5 KW of 110V, 60 Hz of power.

Specifications call for a capability of fabricating hose and tube assemblies on site, along with a diagnostic facility for hydraulic problems capable of eliminating trial and error repairs.

Deployment of units to the field is scheduled to begin early in 1979. The Army anticipates a considerable improvement in equipment downtime, due to on-site maintenance, along with reduction of the over-all repair equipment inventory and significant cost savings.

Hydraulic System Test, Repair Unit

Army Science Conference Program Revised . . .

96 Technical Papers Picked for Presentation From 311 Proposals

Compression of the U.S. Army Science Conference traditional scheduling from four into three days, June 20-22 at the United States Military Academy, West Point, NY, has been announced by the ASC Advisory Group.

Important changes call for the keynote address on the eve of registration and presentation of awards for the best technical papers, usually 15 to 20 from 96 programed, as an attraction at the concluding banquet.

Authors of the best papers will receive from $3,500 to $4,000 in honorariums made possible through the Army Incentive Awards Program. The most prestigious award will be the Dr. Paul A. Siple Silver Medallion, memorializing the U.S. Army's distinguished polar explorer.

Certificates for Scientific Achievement, signed by the Assistant Secretary of the Army for Research, Development, and Acquisition and the Army Deputy Chief of Staff for RDA, also will be presented to authors of papers.

Ninety-six papers programed this year will be evaluated for significant advances as related to potential applications for military requirements by a high level panel of judges, representative of areas of scientific disciplines of Army interest.

The 96 programed papers and 24 supplemental papers, from which substitutions may be made if any of the principal papers should be withdrawn, were selected from a total of 311 narrative summaries of proposed papers. Eligibility criteria limited submissions to Army in-house laboratory personnel.

The U.S. Army Materiel Development and Readiness Command (DARCOM), which controls more than 80 percent of all Army in-house laboratories, accounted for 233 proposals, the Army Corps of Engineers for 27, the Army Medical Research and Development Command for 46, and other activities for 5.

Sixty-nine of the principal and 15 of the supplemental papers are representative of DARCOM scientific and engineering personnel. Ten principal and four supplemental papers were selected from Corps of Engineers proposals. The Medical R&D Command is represented by 15 principal and 4 supplemental papers. Other activities account for one supplemental and two principal papers.

Dr. I. R. Hershner Jr., assistant director for Research Programs, Office of the Director of Army Research and chairman of the ASC Advisory Group, stated at press time for this edition that the keynote speaker, banquet speaker and panel discussion group remain to be selected.

Plans provide for 375 to 425 conference participants, including R&D representatives of the national defense and embassy staffs of the United Kingdom, Canada and Australia.

Technical Papers will be presented all day June 21 until adjournment for an evening picnic or a boat ride (optional) along the Hudson River. Presentation of papers will continue Thursday morning in the Thayer Hotel.

The afternoon will be devoted to a panel discussion followed by a questions and answers session, with the banquet and presentation of awards in the evening in the Officers Club.

Other members of the Advisory Group are Terence G. Kirkland, chief, Research and Development Office, Office of the Chief of Engineers; COL Phillip E. Winter, deputy chief of staff for Research Plans, Medical R&D Command; Dr. Gordon L. Bushey, physical scientist, HQ DARCOM; and Dr. Hermann R. Robl, technical director, Army Research Office, Research Triangle Park, NC.

Alternate members of the group are COL James G. Ton, Corps of Engineers; COL Craig Llewellyn, Medical R&D Command; and Robert J. Zentner, HQ DARCOM.

Conference arrangements are being coordinated by Donald C. Rollins, chief, Conferences and Symposia Office, Army Research Office, and Mrs. Anne Taylor, who has served in this capacity for many years.

Titles of the technical papers scheduled for presentation, the authors and coauthors, and the agencies they represent are:

ARMY MATERIEL DEVELOPMENT AND READINESS COMMAND—*Experimental Method to Determine the Aerodynamic Pressure Distribution on Spinning Bodies,* by Miles C. Miller, Army Armament R&D Command (ARRADCOM), Dover, NJ; *Laser-Induced Opto-Acoustic Pulses in a Flame,* by David R. Crosley, Army Ballistic Research Laboratory (BRL), ARRADCOM, Aberdeen Proving Ground (APG), MD; *Highly Survivable Helicopter Truss Type Tail Boom,* by Thomas F. Erline, BRL; and

System Simulation of STAFF, by R. Gschwind, P. Dietz, J. O'Bryan, H. Rogers and T. Buder, BRL; *PATHAT Gun System—Concept and Feasibility,* by Donald F. Haskell, Mark D. Kregel, George W. Hartwig and Thomas F. Erline, BRL; *Catastrophic Reaction of Compartmentalized Ammunition—Causes and Preventive Measures,* by Philip M. Howe, BRL; *A Vulnerability Analysis of Candidate Engines for the XM1 Tank,* by R. L. Kirby, O. L. Mullen, R. E. Kinsler, W. H. Jack, A. S. Hafer and T. F. Hafer, BRL; and

Evaluation of 105mm HEAT, HEP, and KE Projectiles Against Masonry Structures, by O. L. Mullen, W. H. Jack, R. E. Kinsler and G. P. Beichler; *Aeroballistics of Corkscrew Projectiles,* by Anders S. Platou, BRL; *Transfer of Energy from Charged Asymmetric Transmission-Line Pairs,* by Judith K Temperley and Donald Eccleshall, BRL; *Experimental and Analytical Studies of Jets Formed from Hemispherical Liners,* by William Walters, Janet Lacetera and Robert Jameson, BRL; and

Biomonitoring—A Final Method to Measure Pollution Abatement, by Edward S. Bender, Chemical Systems Laboratory (CSL), ARRADCOM, APG; *Trauma Indices and Applications,* by William J. Sacco, William P. Ashman, Conrad L. Swann and Larry M. Sturdivan, CSL; *Methodology Development for the Identification and Analysis of Trace Contaminants Found on Army Installations,* by E. W. Sarver, W. J. Maurits and M. Kerschensteiner, CSL; and

Strong and Specific Interactions of Some Incapacitating Phenothiazines With Nucleic Acids, by Charles E. Williamson, CSL; *Explosion on a Single Molecule Level: A Conceptual Model Based on Ionization and Fragmentation of TNT Under Electron Impact,* by Suryanarayana Bulusu, Large Caliber Weapon Systems Laboratory (LCWSL), ARRADCOM, Dover, NJ; *Energetic Transient Species Formed Via Electronic Excitation of s-TNB and s-TNT,* by C. Capellos and S. Iyer, LCWSL; and

The Effects of Physical and Chemical Processes on Two-Phase Detonations, by P. L. Lu, N. Slagg and B. Fishburn, LCWSL; *Molecular Studies of the Mechanism of Shock Initiation of Solid Explosives,* by F. J. Ownes, J. Sharma, C. Christoe, Z. Iqbal and D. A. Wiegand, LCWSL; *Computer Aided Self-Forging Fragment Design,* Glenn Randers-Pehrson, LCWSL; and

Improved Ceramic-Metal Composite Vehicular Armor, by Donald T. Rorabaugh, LCWSL; *Dynamics of the Pin Pallet Runaway Escapement,* by F. R. Tepper, LCWSL, and G. G. Lowen, Army Research Office (ARO), Research Triangle Park, NC; *High Strength Filament Reinforced Superalloy Composites for Advanced Turbine Engines,* by I. Ahmad, J. Barranco and W. Heffernan, Benet Weapons Laboratory (BWL), Watervliet (NY) Arsenal; and

Gun Tube Dynamics During Firing of Large Caliber and Automatic Weapon Systems, by Thomas E. Simkins, BWL; *Integrated Avionics Control System (IACS),* by Carl Galanti, Charles Pleckaitis, Anthony Santanelli and George Stech, Avionics R&D Activity (ARDA), Army Aviation R&D Command (AVRADCOM), Fort Monmouth, NJ; and

Velocity Measurements About a NACA 0012 Airfoil With a Laser Velocimeter, by Danny R. Hoad, Warren H. Young Jr. and James F. Meyers, NASA Langley Research Center, Research and Technology Laboratories (RTL), AVRADCOM, Hampton, VA; *Army Helicopter Flight Simulation, a Research and Development Tool for the Future,* by Dale Pitt, AVRADCOM, St. Louis, MO; and

Comparison of the Effect of Structural Coupling Parameters on Flap-Lag Forced Response and Stability of a Helicopter Rotor Blade in Forward Flight, by Daniel P. Schrage, AVRADCOM; *Multiple Electronically Synopsing Hierarchy (MESH),* by Joachim A. Maass, Army Communications R&D Command (CORADCOM), Fort Monmouth, NJ; and

In Situ Measurements of Aerosol Absorption With a Resonant CW Laser Spectrophone, by C. W. Bruce, R. G. Pinnick, R. J. Brewer and G. Fernandez, Army Electronics R&D Command (ERADCOM), Fort Monmouth, NJ, Atmospheric Science Laboratory, White Sands Missile Range (WSMR), NM; *Fourier Spectroscopy of Artillery Gunflash,* by John A. D'Agostino, Roberta E. Dixon, Frank J. Elmer and Robert S. Rohde, Combat Surveillance & Target (CSTA), ERADCOM; and

Unstable Resonators for Army Laser Designators, by T. F. Ewanizky, CSTA; *A New Technique for Doppler Frequency Analysis of Radar Signals,* by Otto E. Rittenbach, CSTA; *Thermal Blooming and Air Breakdown Interaction for Pulsed High Energy Lasers,* by R. S. Rohde and R. G. Buser, CSTA; *Brassboard Modulator for HELS,* by J. Creedon, A. Buffa, J. Carter, G. Hrivnak, S. Levy, J. McGowan, W. Wright and S. Schneider, Electronics Technology & Devices Lab (ETDL), ERADCOM; and

High-Speed Electron-Beam Lithographic Resists for Micron and Submicron Integrated Circuits, by John N. Helbert and Edward H. Poindexter, ETDL; *Silicon Waveguide Line Scanning Antenna for Millemeter Waves,* by K. Klohn, R. E. Horn, E. Freibergs and H. Jacobs, ETDL; *Computer Aided Design, Design Automation and LSI: Keys to High Performance Military Electronics,* by Randolph A. Reitmeyer Jr., ETDL; and

A Four-Channel Polarimeter to Measure Nanosecond Laser Pulses, by Edward Collett, Electronic Warfare Lab, ERADCOM; *The Expend-*

able Set-On Communications Jammer, by Eric S. Litt, Ira Kukafka, Pete H. Hudson and Michael J. McCormick, ETDL; *FLIR Image Enhancement by Automatic Low Frequency Gain Limiting,* by Sen-Te Chow and John J. Pupich, Night Vision Laboratory (NVL), ERADCOM, Fort Belvoir, VA; and

Real-Time and Memory Correlation Via Acousto-Optic Processing, by N. J. Berg, B. J. Udelson and J. N. Lee, Harry Diamond Laboratories (HDL), ERADCOM, Adelphi, MD; *Infrared Diagnostic for Near-Millimeter Wave Sources,* by J. P. Sattler, T. L. Worchesky, K. J. Ritter, G. J. Simonis and W. A. Riessler, HDL;

Electrical Conductivity of Selected Graphite Intercalation Compounds in the Range 4K<T<300K, by Russell Eaton and W. David Lee, Army Mobility Equipment R&D Command (MERADCOM), Fort Belvoir, VA; *Hardening of Countermine Structures,* by David C. Heberlein, MERADCOM; *The Mechanism of Corrosion Inhibition by Sulfonates,* by Paul J. Kennedy, MERADCOM; and

High Energy Metal Hydride Fuel Cell Power Source, Walter G. Taschek and Cornelius E. Bailey, MERADCOM; *The Effects of an Immiscible Binder Component on the Rheological and Mechanical Properties of a Composite Solid Propellant,* by Henry C. Allen and Marjorie T. Cucksee, Army Missile R&D Command (MIRADCOM), Redstone Arsenal, AL; *Real-Time Optical Correlator for Missile Terminal Guidance,* by C. R. Christensen, B. D. Guenther and Juris Upatieneks, MIRADCOM; and

Fog and Haze in Europe and Their Effects on Performance of Electro-Optical Systems, by Oskar M. Essenwanger and Dorathy Anne Stewart, MIRADCOM; *Quiet Radar: Design and Tests,* by M. D. Fahey, G. T. O'Reilly, W. G. Spaulding and R. R. Boothe, MIRADCOM; *The Production of Decaborane—14 from Diborane by Laser Induced Chemistry,* by J. A. Merritt, H. C. Meyer, R. I. Greenberg and G. A. Tanton, MIRADCOM; and

Mie Theory for Non Spherical Particles, by Bruce W. Fowler, MIRADCOM; *MIRADCOM Program in Swept-Gain Superradiance,* by D. W. Howgate, C. M. Bowden and J. J. Ehrlich, MIRADCOM; *New Energy and Cost Saving Techniques for the Production of Dense Foods,* by Abdul R. Rahman, Nancy J. Kelley and Donald E. Westcott, Army Natick (MA) R&D Command (NARADCOM); and

The Impact of Female Anthropometry on the U.S. Army, by Robert White and Gregory DeSantis, NARADCOM; *Pulsed Holographic Analysis of Large Vibrating Vehicle Components,* by Grant Gerhart and Gregory Arutunian, Army Tank-Automotive R&D Command (TARADCOM), Warren, MI; *Gated TV Instrumentation,* by C. David Brown, Army Test and Evaluation Command (TECOM), APG; and

Intensive Tropic Function Test, by Eldon M. Cady Jr., Tropic Test Center (TTC), CZ; *Novel Concepts in Real-Time Optical Tracking,* by Alton L. Gilbert and Michael K. Giles, White Sands Missile Range (WSMR), NM; *Development of a Systematic and Quantitative Method for Evaluating Instructional Materials: Instructional Material Adequacy Guide and Evaluation Standard (IMAGES), TECOM; and*

Characterization of Obscuring Smokes in the Field, by L. L. Salomon, E. G . Peterson, L. W. Burgess, W. Gooley Jr. and F. L. Carter, TECOM, Dugway Proving Ground (DPG), UT; *Laser Rods Fabricated from AMMRC Grown Md: YAG,* by J. Caslavsky and D. Viechnicki, Army Materials and Mechanics Research Center (AMMRC), Watertown, MA; *Proof Test Procedures for Ceramic Missile Radomes,* by C. Freese, D. Neal and E. Lenoe, AMMRC; and

High Energy Laser Hardened Transparent Windscreens for Army Aircraft, by Thomas V. Hynes, Robert Fitzpatrick, Gordon Parsons and John Plumer, AMMRC; *Environmental Effects of the Mechanical Properties of Glass Fiber/Epoxy Resin Composites,* by B. L. Lee, R. E. Sacher and R. W. Lewis, AMMRC; *Life Expectancy of U.S. Army Commercial Design Administrative Vehicles,* by Raymond Bell, Army Materiel Systems Analysis Activity, APG; and

The Strange Behavior of Electromagnetic Waves in Conducting Magnetodielectric Media, by Orville R. Harris, Army Foreign Science and Technology Center (FSTC), Charlottesville, VA; *Computing Internal Cockpit Reflections of External Point Light Sources for the Model YAH-64 Advanced Attack Helicopter (Low Glare Canopy Design),* by Christopher C. Smyth, Human Engineering Laboratory, APG.

CORPS OF ENGINEERS—*Direct Electronic Fourier Transforms (DEFT) for Camouflage Signature Measurement (CSM),* by Joseph F. Hannigan, Army Engineer Topographic Laboratories (ETL), Fort Belvoir, VA; *An Experimental Digital Interactive Facility,* by Lawrence A. Gambino, ETL; *Simulation of Drifting Snow in a Hydraulic Flume,* by James L. Wuebben, Army Cold Regions Research and Engineering Laboratory (CRREL), Hanover, NH; and

Field Use of the Environmental Impact Computer System, by Harold E. Balbach and Edward W. Novak, Army Construction Engineering Research Laboratory (CERL), Champaign, IL; *Analysis of a Nonlinear Electromagnetic Field Penetration Problem,* by William J. Croisant and Paul Nielsen, CERL; *Steel Fibers as Web Reinforcements in Reinforced Concrete,* by Gilbert R. Williamson, CERL; and

The ESSEX Program: Use of Underground Low-Yield Nuclear Weapons in Tactical Warfare, by John N. Strange, Army Engineer Waterways Experiment Station (WES), Vicksburg, MS; *The Influence of Large Runway Surface Roughness on Aircraft Response,* by Walter J. Horn and Landon K. Davis, WES; *Response of Shallow Buried Structures to Blast Load,* by S. A. Kiger and J. P. Balsara, WES; *Tunnel Destruction State-of-the-Art,* C. E. Joachim, WES.

ARMY MEDICAL RESEARCH AND DEVELOPMENT COMMAND—*Improved Therapy of Leishmaniasis by Encapsulation of Antimonial Drug in Biodegradable Artificial Phospholipid Vesicles (Liposomes),* by Carl R. Alving, William L. Hanson, Peter S. Loizeaux and Edgar A. Steck, Walter Reed Army Institute of Research (WRAIR), Washington, DC; and

Determination of Wound Blood Flow in the Thermally Injured Soldier, by Louis H. Aulick and Douglas W. Wilmore, Army Institute of Surgical Research (ISR), Fort Sam Houston, TX; *The Survival of St. Louis Encephalitis Virus in Overwintering Mosquitoes,* by MAJ Charles L. Bailey, COL Bruce F. Eldridge, David E. Hayes, WRAIR; and

Project MILES: Biomedical Research and Coordination in Safe Field Exercises, by LTC Edwin S. Beatrice, LTC David Cours, David J. Lund, David H. Sliney and Paul Wampner, Letterman Army Institute of Research (LAIR), Presidio of San Francisco, CA; *High-Frequency Hearing Loss Incurred by Exposure to Low-Frequency Noise,* by CPT Charles K. Burdick, Robert T. Camp Jr., Ben T. Mozo and James H. Patterson, Army Aeromedical Research Laboratory (ARL), Fort Rucker, AL; and

Scrub Typhus: Mechanism of Infection at the Cellular Level, by Edwin P. Ewing Jr., Joseph V. Osterman, Akira Shirai and Akio Takeuchi, WRAIR; *Human Performance Under Climatic Stress and the Fallacy of the "Average" Soldier: Potentially Serious Implications for Military Operations in Extreme Climates,* by Bernard J. Fine and John L. Kobrick, Army Research Institute of Environmental Medicine, Natick, MA.

First Battle in the Heat; Physiological Logistics for Success, by Ralph F. Goldman, ARIEM; *Cultivation of Human Malaria Parasites,* by MAJ David Haynes, MAJ Jeffrey Chulay, COL Carter Diggs and SP5 Cynthia Hall, WRAIR; *Mathematical Models of Skin Burns Induced by Simulated Postcrash Fires as Aids in Thermal Protective Clothing Design and Selection,* by COL Stanley C. Knapp, F. S. Knox III and Thomas L. Wachtel, Army Aeromedical Research Laboratory (ARL), Fort Rucker, AL; and

Research on Immunization Against African Sleeping Sickness, by LTC Robert M. Kovatch, MAJ Wayne T. Hockmeyer and Bruce T. Wellde, WRAIR; *A New Class of Antimalarial Agents: 2-Acetylpyridine Thiosemicarbazones,* by John P. Scovil, Joseph Bartosevich, Daniel L. Klayman and Carl J. Mason, WRAIR; *Toxicity and Treatment of Sea Snake Envenomation,* by LTC James A. Vick, MAJ Jurgen D. von Bredow, Harry L. Froehlich and 1LT Ronald McGarrigle, Office of the Surgeon General (OTSG), Washington, DC; and

Protection Against Exposure to Multi-Lethal Concentrations of Nerve Agents, by MAJ Jurgen D. von Bredow, Nelson L. Adams, 1LT Ronald E. McGarrigle and MAJ James A. Vick, WRAIR; *Laser Bioeffects: Low Level Effects, Impact on Army Laser Systems,* by Harry Zwick, LTC Edwin S. Beatrice and COL John E. Canham, LAIR.

OTHER R&D AGENCIES—*Development of a Systematic Methodology for the Application of Judgmental Data to the Assessment of Training Device Concepts,* by Dr. Marshall A. Narva, Army Research Institute for the Behavioral and Social Sciences (ARI), Alexandria, VA; *Evaluation of Dual-Texture Gradient Camouflage Pattern,* by MAJ Timothy R. O'Neill, MAJ James M. Brusitus, CPT William L. Johnsmeyer and CPT David L. Taylor, U.S. Military Academy.

Supplemental Papers

ARMY MATERIEL DEVELOPMENT AND READINESS COMMAND—*Generation of High Velocity, Coherent Jets from Dense, Low Sound Velocity Materials,* by A. M. Detrich, R. L. Jameson, M. L. Lampson, J. T. Harrison and A. B. Merendino, BRL; *Design of a 105mm APFSDS Kinetic Energy Projectile,* by W. H. Drysdale, BRL; and

Physical and Mechanical Relationships in Electro Slag Refined (ESR) Steel, by Vito J. Colangelo, BWL; *A Projection Model and an Interactive Algorithm for a Reliability, Availability, and Maintainability (RAM) Policy Guideline of an Airmobile Combat System,* by Harold Y. H. Law and Timothy Evans, AVRADCOM; and

Analysis of POS/NAV Requirements for Airborne RSTA/EW Systems, by John Niemela and Emanual Friedman, ARDA; *A Lightweight Foliage Penetration Radar,* by A. J. Kazules, J. A. McCray and M. A. Fanuele, CSTA; *Single Crystal Semi-Insulating Gallium Arsenide for Micro and Millemeter Wave Device Applications,* by T. R. AuCoin, R. L. Ross, M. J. Wade and R. O. Savage, ETDL; and

Validation of High-Altitude EMP Environments Based on Reported Damage During Operation FISHBOWL, by W. J. Stark, W. T. Wyatt

3 Firms Chosen for Homing Overlay Experiment

Contracts totaling $1.5 million were awarded recently to three companies for the first phase of the Homing Overlay Experiment (HOE), a 7-month study to define the configuration of an experimental interceptor and management and technical efforts required to develop the system.

HOE is part of the Ballistic Missile Defense (BMD) Systems Command's Systems Technology Program (STP). It is aimed at resolving key technical issues in developing interceptor missiles to operate as "overlays" to defensive systems operating at lower altitudes (see artist's concept, right).

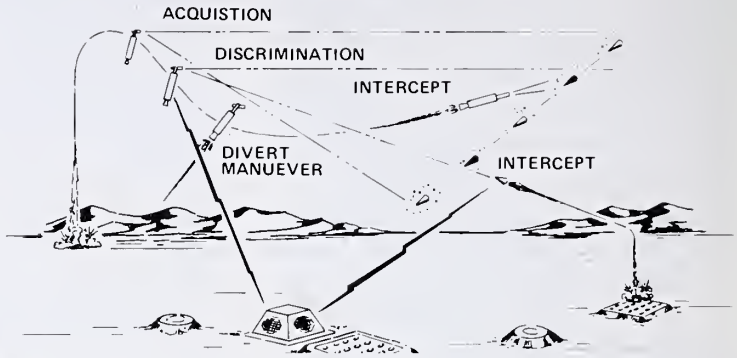
The missile is launched from the ground to high altitude where it locates the group of attacking missiles (acquisition), determines which is a real warhead (discrimination), and flys out to intercept its target (divert maneuver). Its mission is to reduce the missiles lower -altitude systems would have to destroy.

The BMD Systems Command at Huntsville, AL, awarded $500,000 each to the Boeing Co., Seattle, WA, Lockheed Missiles and Space Co., Sunnyvale, CA, and Vought Corp., Dallas, TX. They will work with the McDonnell Douglas Astronautics Co., STP integration contractor.

In the HOE second phase, one contractor will be selected to provide the interceptor for integration into the flight experiment. This includes the systems technology radar and data-processing test facility in operation at the Kwajalein Missile Range in the Marshall Islands. HOE also is aimed at reducing development and deployment lead time of the missiles.

The Systems Technology Program is designed to investigate and evaluate potential systems adaptable to defending high- value targets.

HOMING OVERLAY CONCEPT
(Overlay to Defense of ICBMs)



Chemical Laboratory Expands Coal-to-Gas Research Support

Management and support of coal-to-gas research programs are being increased at the Chemical Systems Laboratory (CSL), Aberdeen Proving Ground, MD, to assist the Department of Energy (DOE) in assuring adequate development of 2d-generation conversion processes.

CSL's primary assistance to DOE is in support of pipeline gas programs for designing, constructing and operating prototype plants to demonstrate conversion of coal to natural gas on a commercial scale, in conjunction with cost-sharing industrial partners.

The laboratory is tasked with process, economic and environmental monitoring, as well as technical support of all pipeline programs.

Hugh T. Reilly is serving as acting chief of a CSL force of 21 engineers and 4 administrative personnel who monitor purchases, changes and tests; supply input; and recommend approval to DOE for all final decisions.

Richard H. Dewey, a CSL general engineer, recently was selected to head a group of engineers supporting the HYGAS Project, a process developed by the Institute of Gas Technology (IGT). A pilot plant has been operating in Chicago for more than four years and has successfully processed caking of Illinois bituminous coal—an achievement that suggests adaptability of the process of coal supplied from the Eastern region of the nation.

Dr. Richard Hutchinson, a CSL chemical engineer, heads a CSL project team working in conjunction with the Conoco Coal Development Co., which has been awarded a $370 million contract to design, construct and operate a coal-to-gas demonstration plant in Ohio.

Another CSL engineer, Mark Jeffries, is a project leader associated with the Illinois Coal Gasification Group (ICGG). The Chicago organization was awarded a $24 million contract for design of a $334 million demonstration plant to be built in Perry County, IL, to produce both quality pipeline gas and low-sulfur crude oil from coal (*August-September 1977 issue*, p. 10).

SATCOM Awards $14.8 Million for Ground Terminals

Initial production of light transportable ground terminals designed to provide worldwide satellite communications in the Defense Satellite Communications System (DSCS) is ordered in a recent $14.8 million contract.

Announced by the U.S. Army Satellite Communications Agency, Army project manager for development of ground terminals for the DSCS, the contract was awarded by the Army Electronics Command shortly before it was disestablished (see page 4 for article on three new commands).

Operated by the Army, Navy and Air Force in the DSCS under operational control of the Defense Communications Agency, light transportable ground terminals are "Joint Chiefs of Staff assets." Slated for acceptance 24 months after the award, three of the terminals will be delivered to the Army, two to the Air Force and one to the Navy.

Designated as AN/TSC-86, the terminal will be used over a 5- to 10-year period with the DSCS-II and future DSCS-III satellite transponders for terminal-to-terminal links.

SATCOM Project Manager for the AN/TSC-86 Fred Knipp said it was planned initially as a contingency and restoral terminal. Use has been expanded to replace the contingency AN/TSC-54 terminals developed in the 1960s; also, for deployment to worldwide locations where no satellite communications terminals exist.

Housed in an S-280 shelter mounted on mobilizers for transport, the AN/TSC-86 uses a variety of baseband and multiplex equipment—compatible also for haul by 2½-ton truck.

Phase-shift-keying (PSK) modulation is used to send and receive high-speed, pulse-code-modulated (PCM) digital data. An automatic tracking 8-foot ground-mounted antenna is provided as the basic antenna for single carrier operation.

When the terminal is configured with the AS-3199/TSC (20-foot) high-gain antenna (G/T-26 db), multicarrier capability is provided for transmission and reception of up to four independent carriers.

The AN/TSC-86 terminal uses a 1,000-watt power amplifier and transmits in the 7.9-8.4 band. It receives at 7.25-7.75 GHz.

PM Knipp said the contract award to the RCA Government Systems Division ended more than four years of design and evaluation effort. He added that the effort has developed a "truly transportable, super-high frequency ground terminal offering the highest assurance of reliable short- or long-range communications to meet the requirements of DSCS strategic users."

96 Technical Papers Picked for Presentation at ASC

(Continued from page 7)

Jr. and Roy Strayer Jr., HDL; *Hybrid Power Source for Vehicular Propulsion,* by Edward J. Dowgiallo, MERADCOM; *Polarimetric Target Indication (PTI),* by Lloyd Root, MIRADCOM;

A Non-Linear Constitutive Relationship for Composite Propellants, by Donald L. Martin Jr., MIRADCOM; *Simulation of Flight Performance of Gliding Airdrop Systems,* by Thomas F. Goodrick, NARADCOM; *The Rapid Evaluation of Hazards from Toxic Waste Deposits,* by Duane E. Long and Martin J. Houle, DPG; and

Applications of a Gated Imaging System in Evaluation of Laser Designator Performance, by William E. Shaw, WSMR; *Radar Absorptive Material from Industrial Effluent,* by J. W. McCauley, B. M. Halpin Jr. and T. V. Hynes, AMMRC, S. D. Eitelman, FSTC.

CORPS OF ENGINEERS—*Comparison of the Performance of Solar Heating and Cooling System vs Theoretical Performance,* by David Joncich, CERL; *Establishing Habitability Factors for the Design of Office Environments,* by Charles Lozar, CERL; *Military Use of Bulk Explosives,* by Hendrik D. Carleton, WES; *Pavement Deterioration and Reliability,* by Victor C. Barber, WES.

ARMY MEDICAL RESEARCH AND DEVELOPMENT COMMAND—*Motor Performance Decrements in Primates Exposed to Sublethal Doses of Soman: The Protective Effects of Pyridostigmine and Tab,* by LTC Martin Chipman and Brennie Hackley, Biomedical Laboratory, APG; *The Mode of Action of Aqueous Chlorine During Disinfection of Bacteriophage f2,* by William H. Dennis Jr., Army Medical Bioengineering R&D Laboratory, Fort Detrick MD;

A Coating Agent for Promotion of Metal-to-Porcelain Bonding, by LTC Eugene F. Huget and Laszlo B. de Simon, Army Institute of Dental Research, Washington, DC; *Medical Defense Against Chemical Warfare Agents, Advances in the Prevention and Treatment of Casualties,* by Richard K. Traub, William P. Ashman, Larrel W. Harris, Willard J. Lennoz and Richard L. Farrand, Biomedical Laboratory, APG.

OTHER R&D AGENCIES—*Use of Computers in Mold Design,* CPT Robert E. Keenan Jr., Los Alamos (NM) Scientific Laboratory.

LAIR Develops Prototype Night Vision Screening Device

Differences in night vision of personnel relative to their adaptability to combat operations under cover of darkness are being measured with a prototype adaptometer developed at Letterman Army Institute of Research, Presidio of San Francisco, CA.

LTC Silmon L. Biggs, M.D., and SP7 Steven Layton of the Lair Department of Surgery are credited with developing the device. Automatically it plots the thresholds at which individuals in a darkened environment are able to perceive light.

Both the long and short wavelengths of the visual spectrum are studied at the same test session, permitting separation and evaluation of functions of the cone and rods of the eye. The task paradigm is identical to that of automated hearing tests, enabling one technician to monitor simultaneously six tests.

The prototype adaptometer reportedly has proved "extremely useful in a clinical setting." For example, the night vision of a 25-year-old Infantry sergeant was evaluated. He was disturbed that he could not see well enough at night to lead his men on night maneuvers. Otherwise he was physically normal, including his daytime vision.

The adaptometer showed that his night vision was 10 times less sensitive than that of the average person, and 100 times less sensitive than that of persons who perform best at night.

A portable dark adaptometer under development for use in the field is designed to be sturdy and compact. It will plot the cone and rod adaptation curves on standard IBM cards while the subject is taking the test.

Projected uses for the field model include identification of personnel who have difficulties in fighting at night; those who have a visual advantage at night; and those aviators who will be the best candidates for nighttime nap-of-the-earth flying.

The field device also is planned for use in screening personnel exposed to hazardous environments of high light levels or noxious gases; also, for determining if new prophylactic drugs affect night vision.

While each person is subjectively familiar with his own dark adaptation process, it is explained, he/she has no good way of knowing how it compares with that of another person.

Actually, there is about a tenfold difference in full adaptation thresholds in the normal population (2σ). Several asymptomatic hereditary conditions may severely impair vision adaptation at night. Some nutritional deficiencies can cause varying degrees of night blindness.

The process of visual adaptation from daylight to the darkened interior of a movie theater, for example, takes place in the retina of the eye. For each person this process follows a relatively fixed pattern.

The pattern is determined by the brightness of the environment before a person passes into the dark, the relative amount of light in that environment, and wavelengths of available light.

The prototype device is able to measure the individual soldier's visual dark adaptation, providing knowledge to protect the soldier with limited night vision, and to enhance utilization of good candidates for night combat action.

New DARCOM Office, Regulation Accent CM/CCM

CM/CCM is an acronym destined to denote an area of increasingly important activity in U.S. Army research, development, test and evaluation effort—as indicated by recent publication of a new regulation and establishment of a DARCOM Office for Countermeasures/Counter Countermeasures.

COL Joseph G. Mikula is assigned staff proponency for Army Materiel Development and Readiness Command Regulation 70-4 as the CM/CCM development manager. He also is associate director for Foreign Science and Technology, Development and Engineering Directorate.

Responsibility for the DARCOM-wide CM/CCM program rests with the commander of the new Army Electronics R&D Command, Adelphi, MD, where the Office for CM/CCM will be directed by COL Gary B. Murray.

DARCOM Regulation 70-4 prescribes guidance to be followed by DARCOM subordinate commands and agencies, involving laboratories, centers, project managers and other activities. Areas to be addressed include all systems which transmit, emit, receive, absorb or reflect electromagnetic, sonic, seismic, olfactory, or optical signatures and signals.

Electromagnetic pulse and nuclear weapons effects are included in the over-all DARCOM program of CM/CCM. Specifically excluded are nonnuclear "hardening," along with chemical and biological hardening, which are responsibilities of the Army Materiel Systems Analysis Activity (AMSAA).

COL Mikula explained that the new regulation and the DARCOM CM/CCM Office reflect a major increase in Army attention to the CM/CCM problem. Increasingly visible evidence of Soviet capabilities in this area over the past decade is a stimulating factor.

Until publication of the new DARCOM Regulation and establishment of the CM/CCM Office, the U.S. Army has not had a formal policy nor programs dealing with the total spectrum of countermeasures and counter-countermeasures.

Natick Developing Microwave Food-Vending Machine

A microwave oven vending machine that will store, cook or heat and dispense well-balanced meals to small groups of personnel assigned to isolated locations, is being developed by the U.S. Army Natick (MA) R&D Command.

Initiated at the request of the Air Force, the NARADCOM project is aimed to serve missile or radar sites where a 24-hour food service capability would be needed, but the cost of a full-time kitchen operation could not be justified.

NARADCOM has food R&D responsibility for all the military services. A microwave oven vending machine could serve aircraft carriers or other military vessels and areas where kitchens or galleys are periodically shut down.

Snack-type items and hot or cold drinks are available but there is no satisfactory system for heating and dispensing a full meal or various dishes that could provide a well-balanced meal within the Air Force 2-minute time limit.

The developmental prototype unit has a section where thermoprocessed foods are stored, a microwave oven to cook or heat the food, and a built-in microprocessing system to program the heating cycle. The machine automatically programs the individual selections for the proper heating sequence—top-browns and crisps where needed, as in the case of french fries, chicken, etc.—and delivers the items at the proper serving temperature, all within two minutes.

To insure that items stocked in the machines are free of microbial contamination, radiometry is being used to detect foods that might be improperly packaged or processed.

Use of a Johnson Laboratory Bactic 201 permits a determination in six hours as compared to the two days usually required for the conventional plate-count test method.

NARADCOM researchers believe that refinement of the prototype microwave oven vending unit may lead to it being as familiar as cigarette, soft drink or snack-item vending machines. It offers, they say, broad use potential for hospitals, shopping malls, lounges or lobbies of apartment complexes.

PROTOTYPE microwave refrigerated vending machine serves up piping-hot, 3-course meal to Air Force LTC Don Van Dyke. The unit is under development by the Army Natick R&D Command, Natick, MA.

Army Reports Successful Tests Of Fiber Optic Cable System

Successful tests of the U.S. Army's first tactical fiber optic cable system were made recently in Leipheim, Germany, by the VII Corps in coordination with the Army Communications Research and Development Command (CORADCOM), Fort Monmouth, NJ.

No special handling techniques were used for the exploratory model. The cable was stepped on and subjected to snap loads while undergoing installation on telephone poles. No failures were recorded during the 16-day test period and excellent quality telephone links were reported.

Installed in a loop-back configuration as a replacement for conventional CX-4566 26-pair cable on an AN/TTC-38 trunk circuit, the system consists of two 12-channel full duplex multiplexers/fiber optic cable modems and a 350-meter length of ruggedized fiber optic cable.

This CORADCOM equipment was developed by the Multichannel Transmission Technical Area, Center for Communications Sciences (CENCOMS), through a contract with Harris, Inc., Melbourne, FL. Similar development of fiber optic facilities is under way to replace metal cable in the AN/TTC-39 switch and Digital Group Multipler systems.

Army Modifies PADS for Continued Developmental Testing

Resumption of field trials of the Position and Azimuth Determining system, being developed for Field Artillery survey support under contract with the U.S. Army Engineer Topographic Laboratories, Fort Belvoir, VA, was announced late in December.

The test phase of engineering development was initiated in May 1977, following delivery of the first militarized version of PADS, and was discontinued to permit modification for improved maintainability and reliability.

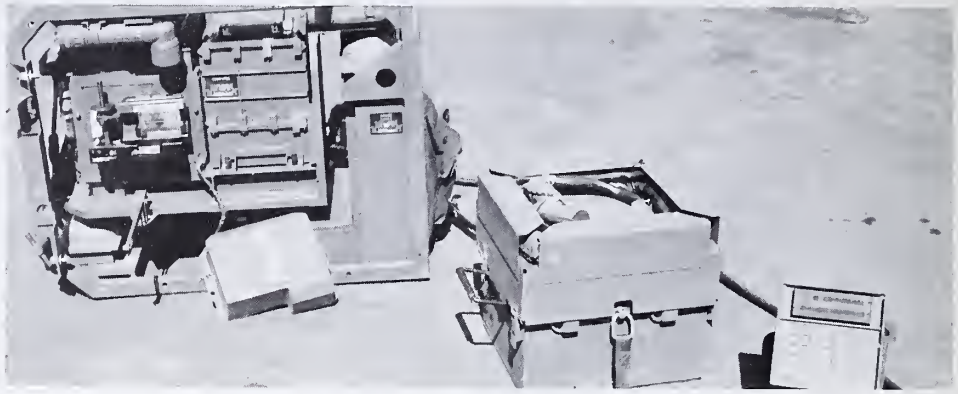
Development Test II is programed to restart in January and continue into June 1978 at Aberdeen (MD) Proving Ground. Operational Test II-A is scheduled from March into June at Fort Sill, OK, home of the U.S. Army Field Artillery School and firing range.

PADS is an inertial (passive) survey system, designed to satisfy requirements of Field Artillery battalion survey units under combat conditions. The self-containing unit is not subject to "jamming" in the communication process since no radio links are required.

Among advantages of the system stressed by proponents are that "it will permit survey teams to keep up with requirements, and it will reduce the requirement from the current 5- to 7-man team to 2 men."

Corresponding reduction in operational cost, plus speed and reduced vulnerability as opposed to other candidate systems under consideration, is used by PADS advocates in countering concern about its substantially higher initial acquisition cost. A first-year buy of nine production units is projected in FY 1979 and delivery to field units is set early in FY 1981.

ETL project engineer Fred M. Gloeckler Jr. explains that PADS will operate in a jeep or helicopter. Used to mark Field Artillery battery centers, it will establish their coordinates along a route of 30 to 40 kilometers (roughly 19 to 25 miles) in two to six hours.



PADS components include primary pallet, left, which contains the inertial measuring unit that senses the vehicle's position, elevation and heading. It also contains the 32,000-word computer. The operator enters instructions and reads out vehicle location and system status via the control display unit at right. The 24-volt d.c. power supply unit is in the center.

To establish effective fire control, survey accuracy requirements have been established at 20 mil horizontal and 10 mil vertical plus one mil azimuth. Initial tests at Fort Sill showed accuracy approximately 6 mil, both horizontal and vertical, and 0.5 mil azimuth.

Gloeckler stressed that speed is "just as important as accuracy," in that the mobility of modern armies gives rise to scenarios in which U.S. artillery units must be capable of moving with unprecedented speed.

Manual survey techniques, he said, are accurate enough for artillery placement but not fast enough to support units under great pressure to "shoot and scoot." He pointed out that on the timetable anticipated for a volatile modern artillery engagement, the task of constantly maintaining a common grid system for effective fire coordination among units "becomes virtually impossible."

PADS reportedly surveys at any vehicle speed with instantaneous readouts. Adaptation of inertial navigation principles used in aircraft, he added, makes possible PADS' real-time capability. The inertial measuring unit contains a stable platform, continually level and pointed north by a combination of gyroscopes and motor-driven gimbals.

Three accelerometers mounted on the inertial platform sense motion changes in the north, east and vertical directions. A 32,000-word computer processes the inertial measurement unit output to determine the current position.

As the system automatically calculates northing, easting, elevation and direction, this information is continually available to the operator, Gloeckler said.

PADS is being put to the test for typical mission profiles requiring three missions within 24 hours. A typical mission lasts two to six hours.

In the primary mission profile, the jeep-mounted PADS is oriented at an initial survey control point. It proceeds via roads or cross country to survey battery locations and alternate firing points, counter-mortar or counter-battery radar locations, and sites for other target acquisition devices.

Another factor cited by Gloeckler is that, if necessary to complete a mission, PADS can be driven while still operating into a medium cargo helicopter and transported across an obstacle such as a ravine.

PADS and its 24-volt battery also can be loaded from a jeep into a light observation helicopter and back, meanwhile continuing to operate and maintain its geographic orientation. Operational Test II results and simulations show that PADS can maintain a common grid, presurvey weapon positions and provide supplemental survey control.

Gloeckler explained that capability to perform these tasks "will add a completely new tool to the artillery surveyor's equipment. The surveyor will be able to support the artillery's mission of amassing firepower under fast-changing battle conditions."

TARCOM Receives First Production M88A1 Vehicle

Modernization of the Army's Medium Recovery Vehicle Fleet passed another milestone with December delivery of the first new M88A1.

The M88 modernization program was started in 1972 and is aimed at production of an improved vehicle; also, upgrading performance of existing vehicles. MAJ Albert C. Pegueros, U.S. Army Tank-Automotive Materiel Readiness Command (TARCOM), Warren, MI, is M88 Readiness project officer.

Program objectives include: replacing the gasoline engine with an AVDS-1790-2DR diesel engine, a modified version of the RISE engine used in the M60 series main battle tanks; increasing the operating range; increasing spare parts commonality with the main battle tank; and improving reliability, availability and maintainability.

Additionally, a 2-cylinder diesel engine-driven generator set with power take-off has been installed. It provides no-load retrieval and pay-out of winch cables, and boom and spade operation.

The program incorporates new production of M88A1s and conversion of existing M88s. Bowen-McLaughlin-York, original manufacturer of the M88, will produce the new M88A1s as well as overhaul and convert M88s to the M88A1 configuration.

Fielding the M88A will begin early in 1978.

TARCOM Deputy Commander BG Andrew H. Anderson; Calvin V. Triick (left), vice-president for Manufacturing, Bowen-McLaughlin-York, and Richard D. Bibb, at BMY, were on hand for delivery of first new production M88A1 Medium Recovery Vehicle.

Former Army Prosthetics Devices Pioneer . . .

Assists VA Effort to Ease Amputee Problems

Pioneering research and development effort to achieve the most effective control systems for artificial limbs, hands and arms lost in combat, accidents or surgery—formerly conducted by the U.S. Army Prosthetics Laboratory, Forest Glen, MD—is now a Veterans Administration responsibility.

Current investigation by the VA Rehabilitation Engineering R&D Center, Chicago, IL, includes possible application of nuclear power technology developed for the Pacemaker—used to sustain many survivors of heart attacks.

Still playing a prominent role in the Veterans Administration research activities, which are extending into the science of bionics—popularized in the fictionalized world of television—is Dr. Fred Leonard. Formerly, he directed the Army Prosthetics Laboratory and the Army Biomechanical Medical Research Laboratory, successor to the APL.

Dr. Leonard, whose work on prosthetic devices covered a quarter of a century until he retired from the Army as a civilian employe, is now associated with George Washington University. Engaged in various research tasks, he is working with the VA by GWU contract.

Honored with a progression of high awards, including the Army Decoration for Exceptional Civilian Service in 1965 and the DoD Distinguished Service Award in 1968, Dr. Leonard was a 1971 recipient of the President's Award for Distinguished Federal Civilian Service.

The DFCS award citation credited him with "saving the lives of many critically wounded American soldiers" in Southeast Asia, through the development of a tissue-receptive adhesive hemostatic agent for non-suture closure of wounds, in place of or as "an adjunct to conventional surgical sutures."

Dr. Leonard is assisting in the VA prosthetic devices research by exploring more deeply into tissue-receptive adhesive hemostatic agents for non-suture closure of wounds, bone grafts, and other medical applications for amputees; also, researching tissue-receptive artificial skin.

Veterans Administration research to improve prosthetic devices includes new bone implant techniques, miniature electronic circuits to bypass spinal cord injuries, and longer-lasting, more natural-looking plastic materials.

The effort to improve 5-year batteries includes making them lighter, and consideration of a nuclear power "trickle source" to recharge them on a sustained basis, a VA spokesman stated. Other work involves electronic cerebral cortex stimulation to permit blind persons to detect objects, and development of devices to convert printed words into spoken words.

Army Low Keys Malaria Drug as Cancer Agent

"No immediate basis for concern" is the U.S. Army response to a recent report that a drug used from 1966 to 1973 for control of falciparum malaria among Southeast Asia troops is suspect of contributing to cancer.

Medical records of the results of using a daily dapsone tablet in addition to a weekly dosage of Chloroquine-primaquine show that this preventive method reduced incidence of falciparum malaria resistant to other normal drugs by "at least 50 percent."

The U.S. National Cancer Institute (NCI) reported recently that research results have established a possible link between dapsone and cancer-producing agents in male rats. However, the dosage rate in the study was about 320 times greater than that given to U.S. troops in Vietnam. NCI scientists used the equivalent of eight grams of dapsone daily on the test rats over a 1½-year period.

Concern over the increasing problem of falciparum malaria in Southeast Asia operations in the early 1960s led the U.S. Army to contract with the University of Chicago and the University of Kansas for a study on effectiveness of dapsone for control by testing 100 persons.

In the mid-1960s another test sponsored by the U.S. Army involved more than 800 leprosy sufferers. Volunteers and others who previously had used dapsone for several years were tested at National Leprosarium, Carville, LA.

Shortly after World War II, testing of dapsone on laboratory animals showed the drug could be effective in preventing and treating certain drug-resistant forms of malaria. U.S. Army field testing of dapsone was conducted in 1966 (Jan.-Feb. and May-Aug.), involving soldiers from the First Cavalry and 25th Infantry Divisions. Researchers reported that results confirmed effectiveness of dapsone.

Engineer Topo Labs' Stockwell Wins Patent Award

Guy N. Stockwell, Army Engineer Topographic Laboratories, Fort Belvoir, VA, was awarded U.S. Patent No. 4,030,218 for invention of a "segmented map and holder."

The invention is a plastic laminated map, segmented for convenience of carrying and viewing in limited operation areas. Potential users include squad and platoon leaders, tank commanders, and pilots of rotary-wing aircraft or limited-range fixed-wing aircraft.

A large map sheet is divided into columns and rows forming 16 segments, with eight pairs laminated back-to-back and joined by a slot-and-ring arrangement for simultaneous viewing of adjacent segments. The cover segment is a small-scale sketch of the entire map, with numbers to guide users in selecting segments (Fig. 1).

A marginal flap at the top of each segment has an elongated slot for a ring that holds segments together to permit easy juxtaposition for reading. Segments can be manipulated to place together two adjacent segments of a column (Fig. 2) or adjacent segments of a row (Fig. 3).

The invention is intended to give the user in the field a pocketsized, waterproof, convenient tool for use in tactical operations. The plastic surface can be written on, erased and reused.

INVENTOR Guy N. Stockwell demonstrates his patented Segmented Map and Holder to SP5 Harold L. Stiles at the U.S. Army Engineer Topographic Labs, Fort Belvoir, VA.

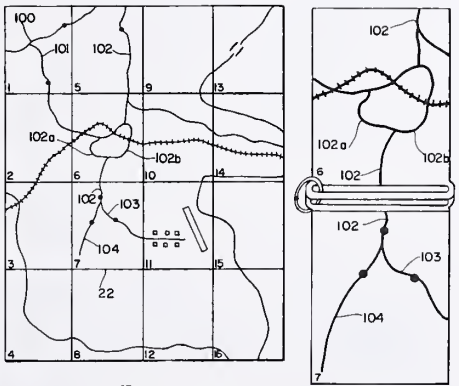


FIG. 1

FIG. 2

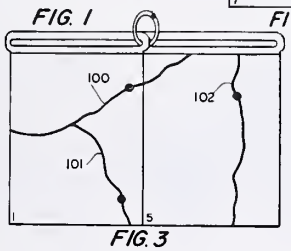


FIG. 3

ARRADCOM Aids Evaluation To Select NATO Ammunition

U.S. Army participation in a NATO Small Arms Evaluation Program that will determine the standard caliber of ammunition for future NATO rifles and/or light machineguns is being supported by the Armament R&D Command.

NATO military officials state that ammunition standardization is essential for the post-1980 period and standardization of Infantry small arms is desirable.

Two calibers are scheduled to be standard for the next family of Infantry small arms weapons. One will be the current NATO 7.62mm cartridge used in all NATO medium support weapons. Alternate designs for ammunition will be tested and evaluated in NATO trials.

One of ARRADCOM's main roles in this program is to provide engineering support for the testing phase. ARRADCOM is also providing the U.S. members of the NATO Small Arms Test Control Commission. Substantial support is also being provided by the Army Management Systems Analysis Activity and the Operational Test and Evaluation Agency.

NATO engineering and field tests are divided into two stages. Technical tests are being conducted in England and Germany to determine performance parameters of all ammunition and weapon contenders. Military troop tests will be conducted at the German School of Infantry.

U.S. ammunition entries are improved versions of the standard 5.56mm cartridges, the XM777 and the XM778, both developed at ARRADCOM. Designed for use in light machineguns, they are compatible with and extend the performance of the M16A1 rifle.

CRREL Scientists, Engineers Assist NSF Ross Ice Shelf Drilling Project

Front page headlines in major newspapers, along with TV and radio broadcasters, have been heralding recently the historic achievement of a National Science Foundation supported team in drilling 1,375 feet through the Ross Ice Shelf in Antarctica to explore waters of the sea below for marine life.

The U.S. Army role, however, has received little or no mention in news media. Dr. Duwayne Anderson, formerly (1966-75) with the Corps of Engineers Cold Regions Research and Engineering Laboratory, Hanover, NH, and five other CRREL employes have contributed to success of the project.

Dr. Anderson is now chief scientist, Polar Programs, National Science Foundation. Involved in the project, currently in extracting cores for study of evolutionary composition of the ice, are CRREL personnel Robert Bigl, James Cragin, Carl Martinson, John Rand and Herbert Ueda.

The CRREL effort on the NSF project, at a site about 400 miles from McMurdo Station, began in November-December 1976. A team headed by John Rand and B. Lyle Hansen, a former CRREL employe now with the University of Nebraska (under contract with the NSF), penetrated to within 300 feet of the bottom of the Ross Ice Shelf. That effort was halted when shifting ice trapped their drilling apparatus at a depth of almost 1,100 feet.

Success in the project this year came a week after an effort failed when a hole burned through the ice with a thermal drill (a rocket-type torch developed by James Browning, a New Hampshire engineer) froze shut before the program of experiments could be initiated.

This drill was evaluated and approved by CRREL engineers following loss of the CRREL-developed drilling system used in 1976. Dr. Richard Cameron, the NSF official charged with overseeing the project, reported that trouble developed with the thermal drill following the first failure.

Dr. Cameron explained that the second attempt, five feet away from the first, had to be halted when the drill flamed out at a depth of 600 feet. It had to be pulled out for repair.

The drill torch cut through the 1,375 feet of ice the first time (the hole that froze shut before experiments could begin) in nine hours. The heating cable was redesigned and constructed on the spot after the second attempt burnout.

When the second burn-through was accomplished, Dr. Cameron commented: "We're in good shape now. We're on the right track." The one-foot diameter hole was then widened for programed experiments.

Existence of marine life had been established at press time for this edition. Analysis of the ice cores now being extracted by the CRREL team, along with study of ocean sediments, is expected to give insight to glaciologists and oceanographers about scientific aspects of the Antarctic Continent heretofore unavailable.

Army Establishes Engineering Services Office

Improved life-cycle production management of weapon systems and equipment is the stated objective of a new Army Product Engineering Services Office (PESO), located at HQ U.S. Army Materiel Development and Readiness Command (DARCOM), Alexandria, VA.

PESO's primary mission, as prescribed by Department of Defense Directive 5000.34, is to assist, consult and advise HQ DARCOM program managers and major subordinate command PMs during all phases of the production management acquisition process.

Production management is defined as the effective use of resources to produce on schedule the required number of end items that meet specified quality, performance, and cost.

Subsequent to initiation of a production program, PESO will participate in system preliminary and critical design reviews, to assure that engineering designs are sanctioned for producibility, and to confirm that design-to-cost goals are attainable.

Other PESO service objectives include:

- Insure that the latest test-proved manufacturing technology is incorporated, or at least considered, in production programs.
- Provide consultant services relative to requests for proposals, statement of work preparation, source selection, manufacturing capability reviews, production readiness reviews, and value engineering on high-cost systems.
- Provide professional engineering services for complex weapons systems which are subject to Army System Acquisition Review Council (ASARC) and Defense System Acquisition Review Council (DSARC) consideration.
- Review and evaluate manufacturing processes including tooling and assembly operations, and develop recommendations to assure that competitive procurement is supported by adequate data.
- Seek solutions to manufacturing problems and operational problems associated with Army inventory equipment.

Additional information relative to the Army PESO (U.S. Navy and Air Force PESOs are also operational elsewhere) may be obtained from Dr. Richard R. Delmar or James H. Donnelly, HQ U.S. Army Materiel Development and Readiness Command, ATTN: DRCMT/PESO, 5001 Eisenhower Ave., Alexandria, VA 22333 (Autovon 284-8298/99 or commercial 202-274-8299).

Facsimile System III Serves 18 Federal Agencies

Eighteen U.S. Government agencies in the Washington, DC, metropolitan area are served by a recently activated Facsimile System III, announced by the U.S. Army Communications Systems Agency Project Manager DCS (Army) Communications.

Tasked in April 1975 to develop the advanced facsimile system, the agency is a major subordinate activity of the Army Communications Command and a multi-service PM office for the Army Materiel Development and Readiness Command, Alexandria, VA.

Identified regionally as WASHFAX III, the system provides automatically switched, high-speed, high-resolution, secure facsimiles.

The system is capable of sending and receiving 10 graphic pages (8½ inches by 11 inches) per minute; also, acceptance of input documents (black and white from color).

Input documents are acceptable in 8½-inch by 11 or 8½ by 14-inch format, and can be transmitted page by page or automatically.

The system can transmit station to station, engage up to 18 terminals in a single conference call, or simultaneously engage six 3-station conference calls. Receipt of documents is acknowledged automatically and the terminal disconnects at end of transmission.

Visual display units depict system status information. Digital signals are encrypted with communications security equipment and are transmitted over 1.544 Mb/s leased circuits.

Responsibilities for system engineering, integration and installation of the communications security equipment are assigned to the U.S. Army Communications-Electronics Engineering Installation Agency, Fort Huachuca, AZ.

Datalog Division of Litton Industries furnished, installed and maintains the facsimile equipment, visual display units and the circuit switch. Chesapeake and Potomac Telephone Co. installed and maintains interconnecting lines.

Washington Area Facsimile III

CRREL 4-Year Study Supports Sewage Land-Treatment Method

Results of four years of intensive study show that the U.S. Army Corps of Engineers' exploratory research on sewage land-treatment systems can be operated on a year-round basis, and, when managed properly, with no long-term impact to the land. Sewage waste water reportedly can be treated to meet federal standards for drinking water.

U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) researchers report that the systems consist of a natural biological-physical-chemical process. Wastewater is renovated by removing phosphorous, nitrogen, and other dissolved chemical compounds, as it moves through or over the soil.

CRREL land-treatment of sewage research at Hanover, NH, consists of studies to evaluate chemical preapplication requirements; optimize the renovation capacity of land-treatment systems; and monitor ground-water quality. Also, to construct and validate a mathematical model to predict quality of percolate water from land-treatment systems.

Four papers presented at the 69th Annual Meetings of the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, reported on the progress of the CRREL program.

Papers and authors are: Corps of Engineers Land Treatment Program—An Overview of 4 Years of Research Accomplishments, by H. L. McKim and I. K. Iskandar; Phosphorous Movement in Land Application—A Potential Problem, by I. K. Iskandar and R. P. Murrmann (U.S. Department of Agriculture); Chemical Analysis of Forage Grasses Receiving Four Years of Wastewater Application, by A. J. Palazzo and H. L. McKim; Mathematical Modeling of Land Treatment of Wastewater, by D. C. Legett and I. K. Iskandar.

DARCOM Late December Major Contracts Total More Than $247 Million

Department of the Army contracts during the final week of December 1977 included 21 awards totaling $247,019,999 issued by subordinate commands of the Army Materiel Development and Readiness Command, as follows:

U.S. Army Troop Support and Aviation Materiel Readiness Command (TSARCOM), St. Louis, MO, awarded $117,752,178 in three contracts. Textron Inc., Bell Helicopter Textron Division, Fort Worth, TX, received a $70,758,833 modification contract to exercise an option for AH-1S helicopters, with related services and establishment of a ceiling price for engineering change proposal 1052 into the option quantity.

Beech Aircraft Corp., Wichita, KS, was awarded a $34,248,956 modification to a fixed-price with economic price adjustment contract for C-12A aircraft. Brunswick Corp., DeLand, FL, will receive $12,744,389 for camouflage screening and support systems.

U.S. Army Tank-Automotive Materiel Readiness Command (TARCOM), Warren, MI, granted four contracts totaling $60,719,809. The largest is a $28,476,000 modification, awarded to AM General Corp., Wayne, MI, for 4x4, ¼-ton, M151A2-series trucks and 4x4, ¼-ton, 106mm rifle carriers, M825 utility trucks.

Oshkosh Truck Corp., WI, received two contracts totaling $30,884,710 for 65,000-pound, GVWR, M911 heavy equipment transporter, commercial tractor trucks. Stewart Warner Corp., South Wind Division, Indianapolis, IN, was awarded a $1,359,099 modification for 60,000 Btu/hr, combustion vehicular compartment heater assemblies.

U.S. Army Electronics Command (ECOM), Fort Monmouth, NJ, let six contracts amounting to $39,408,495. ESL Inc., Sunnyvale, CA, received a $15,212,854 modification for Guardrail Systems with ancillary items; RCA Corp., Burlington, MA, $10,753,000 for AN/GVS-5 hand-held laser rangefinder; and

Baird Atomic, Bedford, MA, $5,867,806 for AN/VVS-2 night vision driver viewers; Ford Aerospace and Communications Corp., Palo Alto, CA, $3,362,163 modification for repair services for the AN/FSC-78 and AN/FSC-79 Satellite Communications Terminals; and

Sperry Univac, Federal Systems, Washington, DC, $1,948,272 for conversion of the Naval Telecommunications System Integration Center 90/60 Communications System; Teledyne Electronics, Newbury Park, CA, $1,264,400 modification AN/APM-305 transponder test sets.

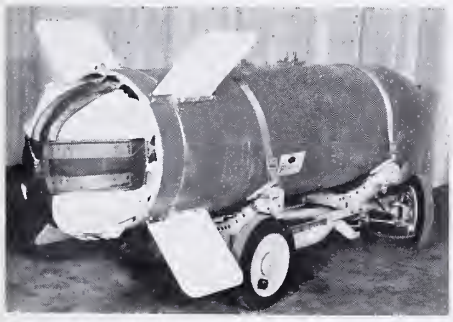
Watervliet Arsenal, NY, is manufacturing 8-inch, M201 cannon tube assemblies and spare parts for M110E2, self-propelled, full-tracked howitzers—two contracts totaling $10,144,412.

U.S. Army Missile Materiel Readiness Command (MIRCOM), Redstone Arsenal, AL, awarded $8,018,661, in three contracts. Westinghouse, Defense and Electronics Systems, Baltimore, MD, received $5,236,000 for digital signal processor modification kits for the Improved Hawk missile system.

Raytheon Co., Missile Systems Division, Andover, MA, was awarded $1,456,683 for depot test equipment on Improved Hawk missile systems, and Metal Masters Inc., Baldwyn, MS, will get $1,325,978 for Hawk guidance and warhead shells.

U.S. Army Armament Materiel Readiness Command (ARRCOM), Rock Island, IL, awarded $8,569,844 in two contracts. Flinchbough Products Inc., a subsidiary of Clabir Corp., Red Lion, PA, will be paid $7,175,730 for 105mm projectile parts and Sperry Univac, Defense Systems, Salt Lake City, UT, $1,394,114 for XM136 helmet sight elements.

U.S. Army Armament R&D Command (ARRADCOM), Dover, NJ, awarded a $2,406,600 modification contract to Honeywell Inc., Defense Systems Division, Hopkins, MN, for M811 fuzes for the nonnuclear Lance missile.



Food, ammunition, communication equipment, medical and other supplies, up to 500 pounds, can be launched from aircraft flying at speeds up to 450 knots and delivered quickly and safely in a disposable fiberglass container developed at the U.S. Army Natick (MA) R&D Command. Navy-developed aluminum containers used by the Marine Corps in Vietnam were salvaged by Vietcong and used to line underground tunnels. To prevent recovery by enemy forces and maintain security of covert operations, new unit can become ashes in 15 minutes.

Army Accepts First Roland Air Defense Fire Unit

Acceptance of the first Roland air defense fire unit, designed in Europe and produced in the United States for deployment with U.S. Army troops abroad and in the U.S. early in 1978, was announced in November.

U.S. Roland Project Manager BG Frank P. Ragano accepted the unit on behalf of the Army from Hughes Aircraft Co. (prime contractor) and Boeing Aerospace Co. (principal subcontractor) at a Boeing facility in Seattle, WA.

Programed to replace the Chaparral missile system during the 1980s, Roland includes a fire unit armed with 10 missiles mounted on the M109 self-propelled howitzer tracked carrier vehicle chassis, surveillance radars operable on the move, an optical sight and a fully traversible (360 degrees) turret.

Transportable by helicopter, the twin-launcher fire module can be operated from ground emplacements or when mounted on vehicles. The first U.S. Army effort to procure a major weapon designed in Europe for deployment with American troops is expected to save the government more than $500 million in RDT&E.

Acquisition of the Roland system is a part of the U.S. Army program to achieve standardization, interchangeability and interoperability with weapons to improve NATO's combat readiness. More than 550 Roland field-replaceable assemblies have been rated interchangeable.

MERADCOM Develops Miniature Solar Energy Unit

Marvels of miniaturization technology applications are almost commonplace innovations now on the American scene. One of the newest is the U.S. Army's 3½-pound solar energy unit to recharge military batteries used in radios and other electronic systems.

Announced early in December by the U.S. Army Mobility Equipment Research and Development Command, headquartered at Fort Belvoir, VA, the unit is sized to be carried in a standard radio backpack by a combat soldier.

MERADCOM spokesmen said it is designed to ease logistics for battery-powered combat communications and navigation equipment. When folded for portability, the unit measures 11½" by 10½" by 1"—considerably less than half the size of a small briefcase. Opened for operation on a built-in stand, the unit is 23 inches wide, 10½ inches high.

Rectangular silicon solar cells, closely spaced edge-to-edge on a honeycomb aluminum panel, provide a high-density power of 10 watts per square foot. The unit can, in maximal sunlight, generate 24 volts at .8 amp and 12 volts at 1.6 amps. Users can orient the unit toward the brightest part of the sky with an integral meter that indicates relative current.

Solarex Inc. manufactured the unit according to MERADCOM specifications as a development in line with MERADCOM's lead agency responsibility for Department of Defense terrestrial applications of solar energy. Short field use power of batteries led to development.

Efficiency of the new unit is achieved by rectangular design of the silicon solar cells, in contrast to circular cells used in most terrestrial applications to date. Circular cells permit only use of roughly 60 percent of the surface area, a MERADCOM spokesman explained.

A thin layer of transparent encapsulant protects the new cells, making them waterproof. Reportedly, they are capable of operating in 140 degrees Fahrenheit to 40 below zero.

Applications of photovoltaic cells, as typified in the new backpack unit, are being investigated by MERADCOM for the Department of Defense and the Department of Energy.

MERADCOM has successfully demonstrated tactical feasibility of photovoltaic systems for a mobile telephone station, remote radar, powering a water purification unit, and a battery charging box to recharge 84 D cell batteries at a time with two 4-foot by 4-foot solar arrays.

SOLAR POWER unit recharging battery-powered combat radio used by SP4 Rory Ries of the 11th Engineer Combat Battalion.

'Power Potential of 10,000 Suns' . . .

WSMR Solar Furnace Planned as One of World's Largest

Conversion of an unused radar tower into one of the world's largest solar furnaces, with heat potential described as "above 10,000 suns," will be accomplished at the U.S. Army White Sands (NM) National Missile Range.

Under a $221,183 contract with WSMR, New Mexico State University scientists, engineers and technicians will work with WSMR counterparts in designing the new facility to upgrade greatly in capability for research the power of an existing WSMR facility.

Dr. Wendell Hull, NMSU assistant professor of mechanical engineering, will direct the project of building a solar furnace with a 400-kilowatt capacity as compared to the existing 30-kilowatt facility.

Only two other solar furnaces will be more powerful, one in France and the other under construction in Sandia Labs, Albuquerque, NM. Another 400-kilowatt furnace is being constructed at Georgia Technical Institute.

Dr. Hull explains that with such a facility, WSMR can substantially broaden its high temperature test capabilities. It will simulate effects of thermal radiation from nuclear blasts on weapon systems, aid in development of new high-temperature materials, and test system components related to solar technology.

Dr. John Hernandez, dean of NMSU College of Engineering, comments: "The contract is important not only because it will create a facility recognized worldwide, but because it is a sign of the university's expanding expertise in the solar energy field."

NMSU has developed its technological expertise in recent years through research grants from the New Mexico Energy Resources Board, he said. "Otherwise we couldn't have taken on a project of this dimension."

Dr. Hull proposed the facility as a research instrument after he spent the last two summers on a research appointment to the Nuclear Weapons Effects Laboratory at WSMR. Among other projects, he worked to improve efficiency of the present WSMR solar furnace.

The new furnace will produce temperatures exceeding 5,000-degrees F. Located at the foot of the tower, instead of in an above-ground chamber, the furnace test area will be more accessible.

Engineering design involves covering the radar's parabolic "dish" with reflective material to serve as the solar collector, and using mirrors to guide (deflect) sunlight down the radar tower to the test area.

For safety, the furnace will be operated by a digital controller. No one will be in the tower during testing. Test operations as well as tracking information for the radar dish will be preprogramed into the controller.

Dr. Hull says that how much heat the new furnace can generate is not yet exactly defined. Compared to the existing furnace, which can create 90 calories per square centimeter per second, the new facility is planned to generate at least 250 calories, and "probably more."

One reason for the added capability is the size of the collector. The one in service is 30 by 30 feet; the new one will be 84 feet in diameter.

Primarily, the new furnace will be used by the Army for testing weapons' ability to withstand nuclear detonations. Federal agencies, such as the Department of Energy, are contracting increasingly to do energy testing at WSMR.

The radar tower conversion project is planned for two phases, the first funded this year for $221,183 for research and design. Hull has assembled a team of NMSU experts in such fields as optics, reflective materials, heat transfer, structural analysis, electronics, instrumentation, and wind loading.

The second phase, not yet funded, is for construction. Richard Hays of the WSMR Nuclear Weapons Effects Laboratory is responsible for technical supervision.

NMSU team members include: Dr. Phillip Smith, head of mechanical engineering, who will study wind-loading and heat transfer problems; and Dr. Milan Cobble, a mechanical engineer, who will be responsible for optical system design. Drs. James Davis and Wirt Atmar, electrical engineers, are working on the digital control system for sun tracking and tests.

Several modifications to the radar will affect its stability and load-carrying ability. Dr. Leonard Traina, civil engineer, will do structural design and analysis and William Fleming will assist with mechanical design.

Dr. James McCrary, Robert Sabin, William Stevens and Harold Connell, all with the WSMR Physical Science Laboratory, will provide design support of instrumentation and safety systems; also, reflective surfacing techniques for the radar dish. Bud Allen will furnish engineering documentation support to all elements. Technical consultation will be provided by Drs. Robert San Martin, George Mulholland and Kenneth White.

SOLAR ENERGY will turn this unused radar assembly at White Sands Missile Range into a world-renowned faciliity through contract efforts of New Mexico State University engineers working with WSMR scientists and engineers. NMSU is designing the solar furance to test materials in heat described as above "10,000 suns."

Army Environmental Agency Marks 35th Anniversary

Charged with responsibility for worldwide support of health and environmental programs of the Army, the U.S. Army Environmental Hygiene Agency (AEHA) celebrated its 35th anniversary in November.

AEHA is the lead agency within the Department of Defense for R&D activities to improve the environment and generate technological advances in health protection.

Established as the Army Industrial Hygiene Laboratory, with the function of assisting Army industrial activities in supporting the war effort, the agency was first located at the Johns Hopkins University in Baltimore, MD.

In October 1945, the agency was transferred to the Edgewood area of Aberdeen Proving Ground (APG), MD, and in 1967 moved into the ultra-modern $3.2 million Wesley C. Cox Building at APG.

Beginning in 1950, the agency's mission was expanded gradually to encompass virtually all environmental hygiene and public health areas.

Current responsibilities include occupational health and nursing, environmental medicine, vision and hearing conservation, toxicology, medical entomology and pesticide monitoring; also, environmental sanitation, hospital safety, industrial hygiene, sanitary engineering, environmental pollution monitoring and control, solid waste management, and radiation protection.

Over 400 AEHA personnel are employed in five directorates and three regional offices.

The *Directorate of Environmental Quality* monitors water and air quality, and solid waste management. The *Directorate of Occupational Health* evaluates safety of work environments, and the *Directorate of Radiation and Environmental Sciences* monitors microwave and laser devices, as well as radiation and pesticides.

The *Directorate of Laboratory Services* is the AEHA laboratory support arm, and the *Directorate of Regional Activities* coordinates operations of the three regional offices at Fort McPherson, GA, Fort Meade, MD, and the Fitzsimons Army Medical Center, Denver, CO.

The AEHA presently is recognized as the only agency of its kind within the Department of Defense with responsibilities in a broad variety of scientific disciplines to improve the environment and protect personnel health and well-being. (See May 1969 issue for more on AEHA.)

WESLEY C. COX Building, home of the USAEHA.

AMMRC Metal Matrix Composites R&D

By Albert P. Levitt*

Metal matrix composites have a high potential for performance under conditions unattainable by monolithic metals, which makes them extremely attractive for a wide range of Army applications.

Performance objectives and capabilities of metal matrix composites, as compared to monolithic metals, are being considered in view of showing the strength and stiffness per pound and per dollar of stationary structures, armaments, bridging automotive vehicles, aircraft and missiles.

Results to date show that each composite system provides advantages for specific types of applications. Developmental promise is further enhanced by the prospect of major reductions in the price of PAN (Polyacrylonitrile) and pitch-base graphite fibers and silicon carbide (SiC) whiskers that should accompany increased application.

This potential is the driving force behind the very active Soviet research and developmental effort. Since the late 60s, the Soviets have made extremely rapid advances in fundamental aspects of composites.

Research areas in which the Soviets are making impressive gains include development of optimum matrix compositions to prevent or deter reinforcement dissolution; steel-reinforced aluminum alloys; reinforced magnesium-lithium alloys; and diffusion-barrier coatings for graphite and refractory metal-fiber reinforcements.

The U.S. Army Materials and Mechanics Research Center (AMMRC) at Watertown, MA, is making significant progress in metal matrix composites. Over-all management objectives are cost-effective R&D, and application of lighter, stronger and stiffer metal-matrix composites to Army aircraft, missiles, armaments, tanks, automotive vehicles and bridges.

This program is coordinated with the Federal Energy Administration, Department of Defense, Defense Advanced Research Projects Agency, Institute of Defense Analysis, the Navy, Air Force, National Aeronautics and Space Administration, industry, universities, professional societies, and appropriate Army commands and installations.

Impressive progress has been made during the past year. Some recent accomplishments include basic and applied research, development, and fabrication of demonstrator hardware; also, preparation and evaluation of new coatings for fibers used in graphite/aluminum composites.

Other advances include identification and control of process parameters for making graphite/aluminum from graphite/magnesium precursors; analysis of factors affecting the strength of an A1 I-beam selectively reinforced with graphite/aluminum; and the fabrication, test and analysis of graphite/aluminum doubler plates for noise and vibration reduction of the CH-47 transmission case.

The CH-47 task is a joint effort by the AMMRC and the Applied Technology Laboratory (a recent redesignation of the former Eustis, VA, Directorate) of the U.S. Army Research and Technology Laboratories, U.S. Army Aviation R&D Command headquartered at St. Louis, MO.

Additional AMMRC activities include fabrication of graphite/aluminum frustra for ballistic missile defense, and fabrication of a graphite/aluminum I-beam by brazing.

A primary goal of the current and future program is to develop an advanced, selectively stiffened helicopter transmission case having reduced noise and vibration as well as decreased maintenance requirements.

Noise reduction would minimize costly hearing disabilities in pilots as well as detectability by the enemy. Reduced vibration would significantly decrease gear wear, costly maintenance and aircraft down-time.

During the past year, AMMRC and the Applied Technology Laboratory have conducted a cooperative effort with Boeing-Vertol to stiffen the CH-47 transmission case with two graphite/aluminum doubler plates.

Successfully fabricated, they were mounted on the CH-47 transmission case and tested. Results indicate that they yielded the greatest reduction in vibration.

Progress is very encouraging and confirms the NASTRAN finite element analysis of transmission case vibration. A joint AMMRC-Applied Technology Laboratory follow-on program is planned for selectively stiffening a subscale magnesium alloy transmission housing with high-performance fibers.

Knowledge and expertise gained from this effort will be applied to development, fabrication and testing of a selectively reinforced full-scale CH-47 transmission case. Successful completion of this program will provide the basis for major, comparable improvements in performance at a reduced cost for all Army aircraft transmission systems.

The metal matrix composites program includes efforts to improve and apply graphite/aluminum composites to all appropriate Army materiel systems. Special emphasis will be directed to improving the transverse strength of this composite system, and reducing its cost.

Other metal matrix composite systems of special interest include silicon carbide whisker reinforced aluminum, B/Mg, FP/A1, and FP/Mg. Relative advantages will be exploited applications, including aircraft, missiles, armament and armor, bridging, and tank and automotive vehicles.

*Albert P. Levitt is a supervisory materials research engineer with the Metals Research Division, U.S. Army Materials and Mechanics Research Center (AMMRC), Watertown, MA.

Guidelines for Technology Exports

(Continued from inside front cover)

course, not yet available.

In the meantime, the Secretary of Defense on Aug. 26 issued interim internal guidance to the Department of Defense with regard to the DoD role in support of U.S. Government efforts to control exports of critical U.S. technology and related products. This guidance, which is based on the recommendations of the Bucy Report, is intended to serve until new policy direction comes out in the directed study.

Since Secretary Brown's interim policy statement of Aug. 26 has given rise to a number of questions, particularly from within the business community, it might be useful for me to summarize its main features.

- DoD's "primary objective" is to protect U.S. lead time in the application of technology to military capabilities "as long as is practical."
- Controls should result in "minimum interference in the normal conduct of commercial trade."
- DoD will place "primary emphasis" on controlling exports to any country of critical technologies and associated keystone equipment.

A. DoD "will normally recommend *approval*" of sales of end products where 1) the technology content is either "difficult, impractical, or economically infeasible to extract"; 2) the end product by itself will not enhance a potential adversary's military potential either because of its technology content or becuase of quantity to be sold; and 3) the product cannot be so analyzed as to reveal U.S. system characteristics and thereby contribute to development of countermeasures.

B. There shall be a "presumption for recommending *disapproval*" if the transaction involves a "revolutionary" advance in Defense-related technology, measured in terms of the receiving country's potential.

C. For end products, recommendations are to be made primarily on basis of assessment that the products' "inherent performance capabilities, or the quantity sold," do not constitute a significant addition to the military potential of the receiving country which would prove detrimental to U.S. national security.

D. End-use statements and safeguards are not to be considered a factor in recommending final disposition of a case.

- DoD will support the transfer of critical technology to countries in which the U.S. has a major security interest, for such purposes as NATO standardization.
- In cases where the initial recipient makes unauthorized further transfers or allows compromise of critical technology, Defense will incorporate its observations of such cases in its assessment of subsequent applications for commercial export, foreign military sales, and the like.
- DoD will maintain a continuously updated list of critical technologies and associated end products.
- DoD will suggest procedural and other changes to other agencies consistent with these various objectives.

HEAT-SENSING THERMOCOUPLES are taped to the big toe of each foot and wired to a digital thermometer that monitors skin temperatures of each of the subjects involved in testing a new ski mountain boot at the U.S. Army Cold Regions Test Center (CRTC), Fort Greely, AK. The purpose was to determine how long it took temperature of their feet to fall to 50° F., about 20 degrees warmer than the temperature required to cause frostbite. Seated from left, in temperatures in the low 20s, are SP4 Beth Poulos, SGT Diane Starling, SP4 Suellen Cochran and SFC Lee Howell.

MIRADCOM, MIRCOM Functional Separation Detailed . . .

Responsibility Changes Leave MICOM Proud Tradition Unscathed

Continuing organizational change is basic to the U.S. Army Way of Life, and is invariably explained objectively as being in pursuance of better ways of doing things for progress, cost effectiveness and efficiency.

When two new major subcommands of the U.S. Army Materiel Development and Readiness Command were created in January 1977 as MIRADCOM and MIRCOM - from resources of the simultaneously disestablished Missile Command (MICOM) - a proud tradition survived unscathed in the temporary turbulence of change.

About seven months later that tradition was enhanced by presentation to MIRADCOM of one of the Assistant Secretary of the Army (Research and Development) Awards for Excellence in the Army R&D Lab Awards Program. The award was presented by the DARCOM Deputy Commander for Materiel Development.

MIRADCOM (Missile Research and Development Command) and MIRCOM (Missile Materiel Readiness Command) are headquartered at Redstone Arsenal, AL, where MICOM was long established.

Recommendations made by the Army Materiel Acquisition Review Committee (AMARC) resulted in the decision to separate, in the new commands, the materiel development and materiel readiness functions formerly performed by MICOM. Former Secretary of the Army Martin Hoffmann explained:

"The two functions are inherently different and management of them takes different skills, different instincts . . . . We feel you will have a stronger organization in each camp by having them independently managed."

MICOM Deputy Commander BG Grayson D. Tate Jr. continued as commander of MIRADCOM until his tour of duty ended in mid-year.

people will survive the reorganizing trauma, will tighten their belts a notch or two, and move out . . . . I see nothing but continued expansion."

MIRADCOM manages research, development, testing and initial acquisition of U.S. Army missiles and rockets. Used as the nucleus of its activities are capabilities within its Technology Laboratory, Engineering Laboratory, and High Energy Laser & Research Lab—along with project managers whose systems are primarily in the development phase of their life cycles.

The Advanced Systems Concepts Office Army Missile Intelligence Agency, and the Defense Advanced Research Projects Office each play special capability roles in supporting the project managers and laboratories. MIRADCOM has a complete procurement and production capability and a complete product assurance capability in support of key staff elements.

Under the operational concept of the new organization, systems vertical management emphasized under MICOM is continued, with the project managers reporting directly to the commander. The operational concept relative to project managers is that as long as there are significant engineering problems associated with a system, it will remain a part of MIRADCOM.

Upon fielding of a system, responsibility normally will be transferred to MIRCOM. Exceptions may be fielded systems with significant development programs.

An example of the latter category is the Pershing IA weapon system, deployed in Germany with United States and Federal Republic of Germany troop units.

The Pershing Project Office is actively engaged in providing support to fielded units to maintain the system in the required readiness posture. Two major improvements, an automatic reference system and a sequential launch adapter, are being fielded to improve system reliability and decrease system reaction time.

Expenditure of missiles in operational testing, troop training and testing of system improvement made it necessary to reopen the Pershing production line in FY78 to replenish the missile stockpile.

In addition to these activities, a Pershing II advanced development program seeks to improve system accuracy by an order of magnitude and increase system effectiveness across the spectrum of target hardness. Improved accuracy will allow increased military effectiveness while using lower yield nuclear weapons.

The combination of these improved characteristics is planned to reduce greatly damage to civilian structures and the population surrounding military targets. Thus, the Pershing Project Office is simultaneously managing activities related to development, production and a fielded system.

Examples of systems totally in the developmental stage are the Viper and the U.S. Roland. Viper is the first weapon in the missile community to go from conception to full-scale engineering development as an in-house development; it also is believed the lightest weight tank killer in the world.

Formulated in one of the former MICOM in-house laboratories, Viper's fuel is believed the fastest burning solid propellant in existence, and it will be contained in a fiberglass motor case, the first to be mass produced at ammunition production rates.

Viper will also be the first Army user of a new concept that configures the shaped-charge explosive in a "pressed-to-final shape" operation. This yields more consistent performance and reduces cost.

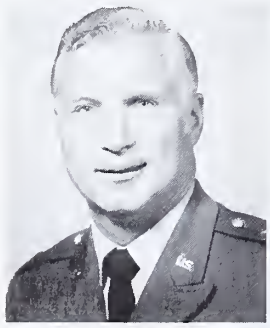
Prior to approval for full-scale engineering development, the Assistant Secretary of the Army for Research, Development, and Acquisition tasked an Army Scientific Advisory Panel (ASAP) ad hoc committee to evaluate advanced development work done on Viper and tell him if the Army had selected the right approach.

The resulting report stated in part: " . . . technical conclusions (reached at MIRADCOM) are as right as excellent engineering can make them."

The contractor team doing the engineering development work and planning for Viper production is carrying on a task started in the MIRADCOM laboratories. Viper has demonstrated in tests its capability as a tank killer. "It has reportedly provided more effectiveness per pound than any competing system, and has outperformed some systems three times its weight." Technology introduced in the Viper program is expected to influence tank design concepts for many years.

The U. S. Roland short-range, all-weather air-defense missile system is distinctive in several aspects. One important factor is that it will be the first major foreign weapon system to be developed abroad, produced in the United States, and introduced into the U. S. Army inventory.

The technical data package required to produce the system is being transferred from Europe to Hughes Aircraft Co. and Boeing Aero-



MG Charles F. Means
MIRADCOM Commander

Dr. Julian Kobler
Technical Director

BG Frank P. Ragano
DARCOM PM of the Year

MG Louis Rachmeler
MIRCOM Commander

BG Patrick M. Roddy
Deputy Commander

MG Charles F. Means is now the MIRADCOM commander. His extensive experience in key R&D assignments began at Redstone Arsenal in 1959, a month after receiving an MS degree in aeronautical engineering from the University of Michigan. In 1950 he graduated from the U.S. Military Academy.

Dr. Julian Kobler became MIRADCOM technical director when Dr. John McDaniel retired, ending a 35-year career with MICOM and its predecessor organizations. Dr. McDaniel commented on his departure:

"I think the future here is really bright. With the people here now and the leadership of General Means, MIRADCOM is in good shape and will continue to expand. I am confident the

space Co., both licensed to manufacture prototypes. Following successful completion of the current R&D effort, or technology transfer, fabrication and test (TTF&T) phase, the production phase will begin.

Because of major emphasis placed on the U. S. Roland project by the Department of Defense, Department of the Army, and the international community, the project management office is the only one within MIRADCOM to be headed by a brigadier general. BG Frank P. Ragano was presented the Department of the Army Project Manager of the Year award at DARCOM's eighth PM Conference in Orlando, FL.

MIRADCOM laboratories, which performed the evaluations of foreign Short-Range Air Defense Systems (SHORADS), also helped staff the original U. S. Roland Project Office with missile experts. MIRADCOM continues to provide requested support with its remaining in-house scientific and engineering expertise.

Other systems assigned to MIRADCOM are the General Support Rocket System (GSRS), Hellfire, Stinger, Ground Laser Designators, 2.75-inch rocket, and the High Energy Laser Program. An Automatic Test Equipment Management Office also is newly established.

Support to the project managers by MIRADCOM's functional laboratories and directorates is achieved through a Matrix Management Concept. MMC principles were adopted in the Missile R&D Laboratory in FY71 to gain more flexibility and responsiveness to higher authority.

The MMC was first used by advanced systems concept teams; in FY 1972 the concept was extended to ad hoc laboratory representatives who interface with project managers. It has proved highly successful in providing a more cooperatively effective relationship among Army major weapon system project managers and the research, development, engineering and test organization.

One MIRADCOM ad hoc representative (an engineer) and an alternate (a technical data specialist) for configurations management are assigned to interface with each PM's staff.

Advanced systems concept teams, first established in the Advanced Systems Concepts Office of the Missile R&D Laboratory, were moved intact with the Advanced Systems Concepts Office to MIRADCOM in the realignment.

Created to stimulate initiation of new materiel concepts, ASC teams work to assure orderly evolution of weapon systems from concept through advanced development. Assigned materiel concepts for consideration, the teams have a responsibility to review and analyze state-of-the-art technology in MIRADCOM laboratories, other U. S. Government agencies and industry.

Advanced Simulation Center Control Console

Electrooptical Simulation System, one of four hardware test areas forming Advanced Simulation Center, provides realistic and precisely controlled environments for the nondestructive testing of a wide variety of sensor systems at MIRADCOM.

The teams coordinate efforts with key laboratory personnel in each of 15 technology areas. Finally, they establish and manage programs to integrate techology into weapon systems concepts that have potential for satisfying an urgent Army need or requirement.

ASC teams maintain liaison with industry in their specialized areas, providing a primary source of information. Industry is thus aided in making decisions on where to expend R&D funds to gain an advantageous competitive posture.

Each concept team is headed by a career military officer who maintains close liaison with Training and Doctrine Command (TRADOC) agencies and other Department of Defense elements. Each military leader is assisted by one or more engineers with the ability to integrate advanced technology.

One of the major elements of MIRADCOM - and the largest with about 22 percent of the command's total personnel strength - is the Technology Laboratory headed by Dr. Julian S. Kobler. The principal mission is to expand the technology base from which missile weapon systems concepts are generated and developed.

In addition to a research mission in missiles and high-energy lasers, the six TL directorates perform exploratory development in the 15 technology areas mentioned earlier.

Technology Laboratory personnel also perform advanced development. Scientific and engineering support is available to MIRADCOM project managers and to MIRCOM and other DARCOM or DoD elements having project or system management responsibility.

An important example of TL support enhances the capability of the Tactical Software Center established in July 1975. The center is responsible for missile computer software and hardware research; also, for providing development and acquisition support to all MIRADCOM, MIRCOM and DARCOM project managers in the Redstone Arsenal area.

Another example of TL effort deals with AN/TSQ-73 (Missile Minder Command and Control System) and the Hawk missile system software. Under one organization, coordination configuration control, design, and test methodology are more consistent; improvements in software development and test are more quickly implemented.

This centralized approach leads to reduced cost of software development and maintenance because of sharing of resources, facilities, and technical expertise when required.

Operation of the U. S. Army Advanced Simulation Center (ASC), a $40 million facility dedicated Mar. 10, 1976, is assigned to the Technology Laboratory. Total support is available for weapon system development. The mission is to provide the Army with a "hardware/man-in-the-loop capability" where feasibility for design, mechanization, advanced development, simulation, and comprehensive evaluation of missile hardware can be achieved.

In addition to accelerating the RDT&E phases of a program, the center increases the level of confidence that a successful system will result.

Program costs are reduced through minimization of flight testing and early identification of potential false starts. Advanced planning, design and system implementation are a continuous effort to insure that end products reflect current technology advancement in weaponry.

The Advanced Simulation Center has performed in a steadily expanding research and development role for elements of the Army, Department of Defense, other U. S. Government agencies, and for industry.

Technology Laboratory responsibilities include DARCOM lead laboratory functions in guidance and control and terminal homing, operation of the Redstone Scientific Information Center (RSIC), and the In-House Laboratory Independent Research (ILIR) Program initiated late in 1962.

RSIC has what is believed the largest, most complete collection of missile and related science and technology documents and books in the world. Included are about 1.7 million documents on missiles and aerospace technology subjects, 200,000 catalogued books and volumes of periodicals, and some 600,000 specialized items such as patents and translations.

RSIC also maintains "real-time" terminals linking MIRADCOM with the Defense Documentation Center computer in Washington, DC, and the National Aeronautics and Space Administration computer in Maryland.

The ILIR Program consists of tasks not

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funded in regularly assigned programs, but proposed tasks are evaluated for potential importance in accomplishing R&D missions. The program provides scientists and engineers an opportunity to maintain and increase competence by doing original work in areas of personal interest; it also has served as an effective catalyst in the Army's internal research and development activities.

Research, exploratory development, and nonsystem advanced development in high-power/energy laser science and technology areas, are managed by the command's High Energy Laser Laboratory, which performs DARCOM lead laboratory functions in this area.

High-energy laser development and long-range planning are coordinated with other U. S. Army and government agencies, industry and universities to assure a continually strong technology base for devices and applications.

The Missile Intelligence Agency (MIA) continues to perform its mission with essentially no change as a result of the MIRADCOM/MIRCOM realignment of functions except for the added interface with MIRCOM. Activities still involve the national intelligence community, U. S. Army agencies, and the Department of Defense.

MIA primary responsibilities associated with MIRADCOM's R&D mission are acquisition, production, maintenance, dissemination of scientific and technical intelligence, and intelligence data handling systems.

Management programs directed to MIRADCOM by the Defense Advanced Research Projects Agency, the Director of Defense Research and Engineering, and other Department of Defense agencies and service commands are the responsibility of the DARPA Projects Office at Redstone Arsenal.

In areas of strategic technology, tactical technology, materials sciences, and technology assessment, these research programs identify, explore and demonstrate advanced concepts and technology that could have a major technical impact upon future military defense capabilities. These programs offer a significant source of material for use in the development of future Army missile systems.

Directorates supporting MIRADCOM's mission include Plans and Analysis, Product Assurance, and Procurement and Production. In addition to its in-house activities, the latter directorate provides procurement planning, negotiation and execution, and production and surveillance for the Patriot missile system.

Operation of test and evaluation facilities for experimental, development, and quality tests is a function of the Engineering Laboratory. Activities of the U. S. Army Field Office, Eastern Test Range at Patrick AFB, FL, support MIRADCOM and MIRCOM.

Other MIRADCOM staff support elements are the Foreign Intelligence Office; Secretary of the General Staff; Management Information Office; Office of the Comptroller (exclusive of finance and accounting); and the Special Staff of advisers - scientific, legal, logistics, small business, etc. - who report directly to the commanding general.

MIRADCOM's mission is to completely manage and control the materiel development and initial acquisition processes which are prerequisites to total Army readiness. A decisive factor is maintaining a broad technology base to provide the most advanced concepts essential to qualitatively superior missile systems; also, to shorten development time and ensure the lowest practicable cost through maximal emphasis on technical ingenuity and leadership.

Missile Materiel Readiness Command Mission, Capabilities

MIRCOM is assigned logistic support and operational readiness missions for deployed missile and rocket systems, including free-flight rockets, guided missiles, ballistic missiles, target missiles (including special-purpose targets for testing and training for assigned materiel).

MIRCOM manages missile launching and ground support equipment, missile fire control equipment, and air defense missile fire coordination equipment, as well as special-purpose and multi-systems test equipment. MIRCOM also manages all aspects of foreign sales of Army missiles, which totaled about $500 million in FY77 and are expected to approach $1 billion in FY78.

MIRCOM also is responsible for operation of the Redstone Arsenal Support Activity, which provides installation/post support services for all U.S. Army and Department of Defense elements at Redstone Arsenal. Included are MIRADCOM, the TRADOC (Training and Doctrine Command), Missile and Munitions Center and School, MEDDAC (Medical Department Activity) and others.

MIRCOM's four project offices oversee all phases of research, development, procurement and production, distribution, and logistic support of five weapon systems: Hawk, Chaparral/FAAR, TOW, Dragon, and Lance.

HAWK (Homing All-the-Way Killer) is a surface-to-air missile designed to defend against low-flying enemy aircraft or guided missiles. Using an advanced continuous wave radar homing guidance system to discriminate against ground clutter, it also features an illuminator radar that "lights" the target with a beam of radar waves. The missile tracks its target by following radar energy reflected by the target.

Ground support equipment in a HAWK battery includes a Pulse Acquisition Radar, a Continuous Wave Acquisition Radar, a Range Only Radar, two Illuminator Radars, six 3-missile launchers, a Tracked Missile Loader-Transporter, and the Battery Control Center, which is the operations nerve center. The system can be airlifted by helicopter and medium-sized aircraft.

The first Army HAWK missile battalion was activated in June 1959. In 1972 the Army Materiel Command—now DARCOM—gave Pueblo Army Depot the mission of converting Basic HAWK to Improved HAWK, which has demonstrated that it is a much more reliable and accurate air defense weapon than its predecessors.

Improved HAWK features one new major piece of equipment, an Information Coordination Central to provide automatic friendly aircraft identification and automatic missile firing through the use of a computer. Other capability enhancements include new guidance electronics, a larger warhead and improved motor propellant.

The Improved HAWK system introduced the "certified round" concept, eliminating the need for field maintenance and adjustments; it is also more mobile than Basic HAWK in that it is mountable on self-propelled vehicles. The first Improved HAWK systems were delivered to U.S. troops in Europe in June 1973.

Chaparral is an air-defense, guided-missile system used against low-flying enemy aircraft operating in the forward area. This quick-reaction, highly mobile, surface-to-air missile system has the capability of destroying high-performance, high-speed jets as well as lower-speed propeller and rotary-wing aircraft. Chaparral complements other Army air-defense weapons, covering the battlefield above the range of Stinger and Redeye, and below HAWK.

The Chaparral consists of an infrared heat-seeking missile, a launcher and a tracked vehicle. The launcher contains a rotating mount (turret) with four missile launch rails, providing the gunner with means to aim and fire at a target. The missile is carried and handled as an assembled single round.

The missile is aimed by the gunner in the mount who keeps the optical sight aligned with the target. After launch, the missile automatically guides on the target's heat source.

Chaparral was deployed in 1969 but an improved version, with a 360-degree intercept capability and a new fuze, entered delivery to the field in July 1977. A compact highly mobile Forward Area Alerting Radar (FAAR) serves as the "eyes" of Chaparral; it provides early detection of low-flying supersonic and subsonic aircraft, relaying information to antiaircraft sites.

Dragon is a medium antitank/assault weapon system developed for the Infantryman to replace the 90mm recoilless rifle. Weighing only 31 pounds, Dragon is the Army's first guided missile system light enough to be carried by one man and shoulder-fired. With a warhead big enough to kill most armor and other Infantry targets encountered on the battlefield, it was deployed with U.S. troops in Europe in 1975.

Because of its light weight, Dragon is especially effective in airborne and airmobile operations. Where the terrain is difficult to negotiate for wheeled and tracked vehicles—such as assault river-crossing operations, heavily wooded or mountainous areas—Dragon emerges as the most effective weapon for asault and antitank roles. It can be used defensively to cover armor approaches into the platoon area, and offensively against hard or soft targets.

Dragon employs a command-to-line-of-sight guidance system, including a reusable tracker and a disposable round. The round is a launcher and missile prepackaged as one unit in production. The tracker has a sighting telescope for the gunner, a sensor device, and an electronics package.

Dragon features a unique propulsion system in which 30 pairs of small rocket motors are mounted in rows around the missile body. After the gunner fires, he holds his sight on the target and the tracker activates the thrusters, automatically guiding the missile to the target.

The TOW (Tube-launched, Optically tracked, Wire-guided) missile is being produced for the Infantryman as a heavy antitank assault weapon system, effective against both stationary and moving targets at close and long ranges. Weighing about 171 pounds, the launcher may be carried by troops and fired from a ground emplacement, or mounted on a variety of vehicles.

TOW features a sophisticated guidance system, consisting of three main components: steel wires, an optical source and sensor, and a small computer. When the missile is launched, an optical source goes into operation and is tracked by a sensor on the launcher. As the gunner

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Your Generators Are Too Noisy

By T. W. O'Connor Jr.

Silently generated electric power is a necessity for the front-line field commander in a tactical situation where nondetection often means unit survival and success of the mission.

The advent of local noise ordinances, Occupational Safety and Health Act (OSHA) Standards, and emphasis on pollution abatement including noise, has brought pressure to bear on both the military forces and civilian industry to reduce noise on equipment and machinery.

The Mobility Equipment Research and Development Command (MERADCOM), with support from the Department of Defense project manager for Mobile Electric Power (PM-MEP), is taking a dual approach to the generator noise problem.

The first approach, though longer range, is to develop a family of Silent, Lightweight, Electric Energy Plants (SLEEP), based on fuel cell technology, to replace the current tactical family of gasoline engine-driven generator sets, 0.5 to 5 KW. The first member of this silent family wil be the 1.5 KW fuel cell, scheduled for fielding in the early 1980s.

The 3 KW and 5 KW sizes are scheduled to follow, with projected fielding dates in the mid-1980s. The 0.5 and 10 KW sizes currently have lower priority, with a later delivery schedule, and the 10 KW size may be either a fuel cell or a silenced turbine generator set.

Although the fuel cell (SLEEP) family is limited currently to the 0.5 to 10 KW-size range by the Required Operational Capability (ROC), recent commercial advances in fuel cell technology—where sizes from 25 KW to 26 megawatt have been demonstrated—may well show that these power plants are feasible replacements for the present family of diesel generator sets, 15 through 200 KW.

The second approach involves reduction of noise on existing generator sets by the installation of acoustic kits or housings. In response to overheating and noise problems reported on tactical MIL-STD (military standard) gasoline generators operating in revetments in Southeast Asia during the Vietnam war, thermal/acoustic kits were developed for the 0.5, the 1.5, 5 and 10 KW sizes. They permit revetment operation with no adverse effect on set performance.

The kit reduces noise by about 10 to 12 db(A) (decibels measured to the "A" scale); more important, it permits safe revetment of the set by channeling the intake air and dissipating the hot exhaust. Proper revetting silences sets.

1.5 KW, 60 HZ Generator Set

As a follow-on to the thermal/acoustic kits, and to provide an interim silent generator until fuel cells are available, a housed 1.5-KW MIL-STD gasoline generator set was developed. When enclosed in noise shielding, this set is inaudible at 150 meters, has a low infrared heat signature, and does not require revetting; it weighs 217 pounds compared to 125 pounds for the basic set.

Noise reduction on the larger DoD family of diesel sets, 15 to 200 KW, is more difficult. However, prototype acoustic kits have been developed for the 15, 30, and 60-KW sizes. They reduce noise by about 12 to 15 db(A), which meets health standard requirements. Kits have not been developed for the 100 and 200-KW sizes; however, similar technology would apply.

Gasoline, diesel and turbine engine-driven generator sets are too noisy for special military requirements. When operating at rated loads, the noise levels are in the 85 to 95 db(A) range. Noise reduction changes on sets of these types increase their weight, cube, complexity and cost—almost directly proportional to the amount of noise reduction desired.

Firm and quantitative noise requirements for generator sets have not been established other than the SLEEP ROC approved in 1975, which applies only to sizes 10 KW and below.

The most cost-effective approach to generator noise control is during the design phase, when effective noise reduction can be incorporated. Adapting noise reduction measures to existing equipment is a costly and, at best, a marginally satisfactory approach.

An alternative to generators, where commercial high line power is available, would be substitution of a family of power conditioners that would meet requirements of using equipment. MERADCOM is developing this family.

60 KW Diesel Engine Generator

In summary, development of the SLEEP family will provide cost-effective silent power. Modification kits and noise reduction measures for existing sets can be used, as required, to meet health standards, local ordnances and special requirements. Noise abatement housings and kits have been developed and evaluated. However, they are not currently available through normal supply channels. Firm requirements must be set.

MERADCOM engineers have recently been visiting Army units in Europe to demonstrate potential return on investment (ROI). The command stands ready to finalize their development and availability subject to necessary requirements and funding.

TRELYON W. O'CONNOR JR. has been deputy chief of the Electrotechnology Department at the U.S. Army Mobility Equipment R&D Command (MERADCOM), Fort Belvoir, VA, since 1971. The department was redesignated as Laboratory 3000 in 1975 when it was given responsibility for environmental control equipment.

Since joining the forerunner organization to MERADCOM in 1953 as a project engineer in the Technical Service Department, he served as chief, Mechanical Standards Section (1956-61); chief, Topographic Materiel Branch, Engineering Department (1961-66); and deputy chief, Electrical Engineering Division (1966-71). His employment in industry includes two years as a power utilization engineer with Rural Electrification Administration and one year as an engineer with Sears Roebuck and Co.

O'Connor earned a BSAE degree from Virginia Polytechnic Institute in 1948, has passed requirements in business administration courses at the U.S. Department of Agriculture Graduate School, and has completed senior executive development courses within the Department of Defense. He is a registered professional engineer and a member of various professional organizations and societies.

Technical Paper Reports on Propagation Integrity

Propagation Integrity for Microwave Instrument Landing Systems is the title of a technical paper presented at the 25th Technical Meeting of the Guidance and Control Panel, Advisory Group for Aerospace R&D.

Authored by Paul S. Demko, an electronics engineer with the U.S. Army Avionics R&D Activity, Fort Monmouth, NJ, the paper is the result of five years of research. It stresses that correct polarization for microwave landing guidance systems is the best approach for reducing multipath interference.

Multipath interference occurs when microwave guidance signals are reflected from vertical obstacles such as buildings. Interference can deny required guidance or cause a pilot to receive erroneous information leading to potentially disastrous situations.

Microwave landing system technology is reportedly attracting increasing interest as the possible successor to conventional high frequency/ultra high frequency instrument landing systems now used by civilian and military air terminals.

It is believed that the next generation system has the potential for vastly improving operational capabilities in foul weather by permitting safe aircraft landings at all types of facilities without requiring visual references outside the pilot cockpit of the aircraft.

Laser Technology: A Major Military Resource

By William S. Alcott

Most articles described as dealing with laser applications address only one specific application or at most a small number of related applications. If a general overview of the scope of laser applications is required, it usually is necessary to search out a series of articles.

This article will try to summarize concisely the extent of the laser technology and the broad range of pertinent applications. The singular purpose is to demonstrate that this area of international scientific and technical research and development is rapidly building, not just devices, but a family of capabilities.

In total, the devices are a national resource of great value and utility to the military, industrial, and commercial spheres of activity.

Within the catalog of scientific and technical areas of activity, the laser ranks among the very top in terms of diversity, both in device types and in applications. Few discoveries have expanded in scope and utility as rapidly and broadly as the laser.

The R&D community has produced three major families of lasers (gas, liquid, solid) and is working on a fourth (force field). Each of these families consists, as shown in Figure 1, of many specific types, which offer wide ranges of parameters such as power, frequency, size, etc.

Continuing identification of additional applications drives the R&D effort, both to improve capabilities of devices and to develop completely new devices having the desired parameters.

The unifying feature of various laser devices is that they all consist of an energy storage system (molecular, electronic, ionic, etc.), in some form (liquid, gas, solid), which is induced by an energy input to assume a short-lived, unnatural, inverted energy state.

When this energy system reverts to its natural arrangement, it emits a unique type of radiation called coherent. Groupings in Figure 1 result from some distinguishing feature, material, or technique used in that particular device or family of devices.

For example, the so-called TEA laser, as shown in the diagram, uses a gaseous energy system (usually CO_2), and an electric discharge technique to input energy. It is considered unique in that the discharge is introduced at right angles (or transversely) to the gas flow, and the gas tube is kept at atmospheric pressure. Hence it is called a Transversely Excited Atmospheric (TEA) laser.

No attempt will be made to explain distinctive features of other laser types, since details are readily available in the technical literature. The point is that within each particular type a host of variables exist.

When considering the whole technology, the combinations and permutations of materials and configurations have reached tremendous proportions. This range of characteristics offers the application engineer or research scientist a wide latitude. Each discovery or improvement seems to open new areas calling for exploration.

Expansion in technology, while expensive, has provided capabilities of great value to the military on the battlefield, in the arsenal, and in the R&D laboratory. Industry and commercial activities, even in the biomedical arena, have benefited by new capability advancements to perform individual roles.

Not until one considers a specific listing of the major applications is a real appreciation gained of the scope of the contributions made by laser technology.

The diversity of applications is apparent in Table 1, which is intended only to illustrate the scope and is in no way an exhaustive listing. It does, however, reflect the variety of systems and techniques that are encountered in the major application areas. Each of the areas, in turn, consists of many specific situations calling for tailored solutions.

Requirements for a battlefield, tank-mounted laser rangefinder, for example, call for an equipment solution much different from that for a ballistic missile defense rangefinder.

Designation by laser may employ a guided missile instrumented to "home in" on the reflected laser radiation, or it may use a guided missile instrumented to home in on the infrared energy radiated from a hot spot resulting from a laser beam.

Power requirements, aiming and tracking capabilities, and even duration of a laser beam on the target, vary significantly in these two cases, involving quite different systems.

Contributions of laser technology in the producing military arsenal, and in the supporting R&D laboratory, are possibly of an importance equal to that of battlefield applications. These contributions permit specialized applications to accomplish:

- Processing of material of unique or unusual

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TABLE 1

Representative Laser Applicatians

Military capabilities	Industrial processes	Research areas
Ranging	Cutting	Spectrascapy
Radar	Welding	Micracutting
Designatian	Hardening	Laser-induced chemical reactians
Identificatian	Alignment	Energy generatian (CTR)
Cammunicatian	Pasitianing	Prapulsian
Illumination	Etching	**Commercial systems**
Detectian	Testing	Check-aut price readers
Simulatian	**Biomedical techniques**	Railraad car sarters
Training	Internal examinatian	Newspaper plate making
Display	Internal treatment	Identificatian systems
Optical data processing	Eye surgery	3-D displays
Cauntermeasure	Cauterizatian	Infa. processing & starage
Pasitian reference	Dental pracedures	Cammunicatians
Landing systems	Research taal	Mapping & surveying
Weapan		

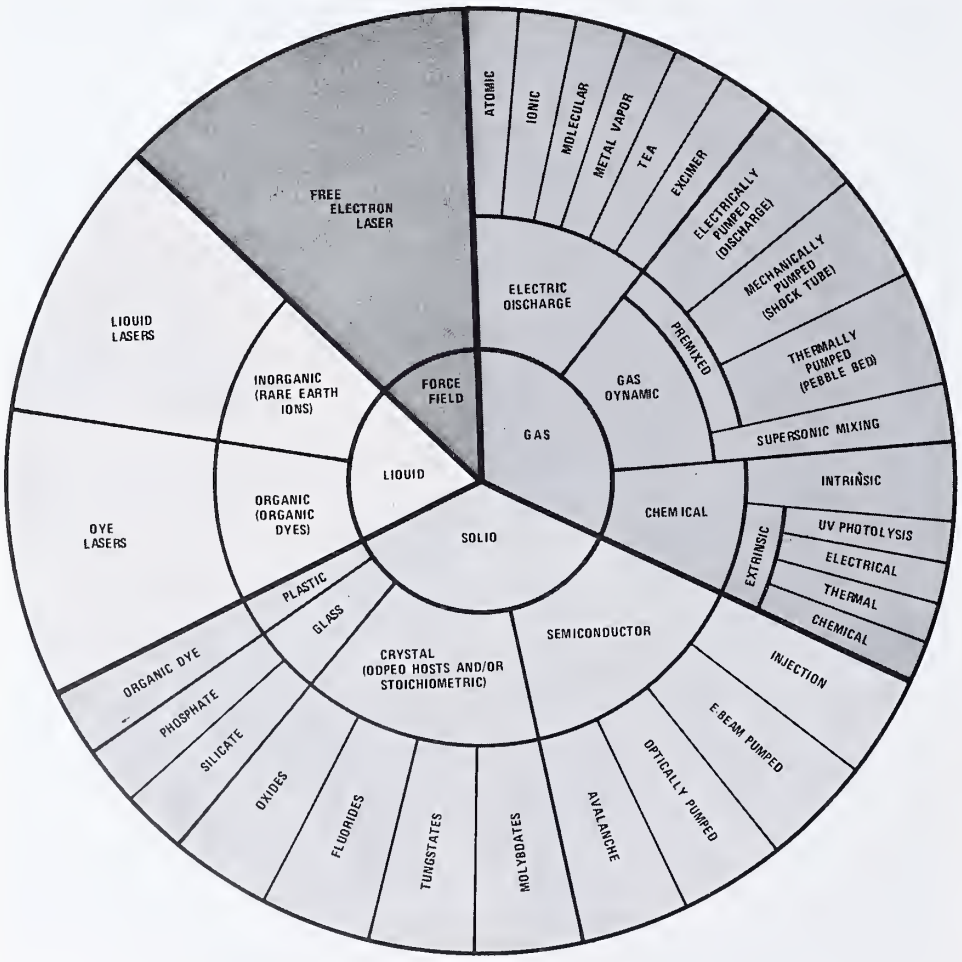


Fig. 1. Principal Laser Categories

Guthrie Recalls Explorer I Role as 20th Anniversary Speaker

Speaking as U.S. Army representative at the Army's Explorer I Earth Satellite 20th Anniversary Commemorative Banquet in Huntsville, AL, DARCOM Commander GEN John R. Guthrie looked back on his LTC role, serving as the DA staff project officer.

GEN Guthrie opened by paying his respects to some of the many distinguished guests, including Governor George Wallace; James Record, chairman, Madison County Board of Commissioners; GEN Durwood L. Crow (USA, Ret.), assistant to the NASA Deputy Administrator: and Dr. Eberhard Reese, former director, George C. Marshall Space Flight Center. Then he continued:

"This has been quite a day for me. I have had the opportunity to see and talk with many people for whom I have the greatest respect and admiration. Together we have rekindled some of the spirit that first took the United States into space. It has been a day I shall long remember.

"Let me say, as a spokesman for the Army, that we appreciate your invitation to participate in commemorating an event so important to this community, the Army and our country.

"There was a suggestion several months ago, briefly considered, that this date should be observed with some sort of event in Washington. Here in Huntsville is where what happened 20 years ago tonight had the most impact. Here is where it is best remembered. Here is where this event belongs.

"Together with thousands of other soldiers and government civilian employes, I had a small part in the events of Jan. 31, 1958. My job . . . involved keeping up with developments at the Army Ballistic Missile Agency, Jet, Propulsion Lab, and Missile Firing Lab at Cape Canaveral.

The job also involved keeping Secretary of the Army Wilbur M. Brucker, General Maxwell Taylor, then Chief of Staff, and the elements of the Army informed. Whenever someone asked, "What are General Medaris and Dr. von Braun up to?", LTC Guthrie was supposed to have the answer.

"I use the word 'supposed' with due consideration. Keeping track of what those two gentlemen were up to in the 84 days preceding Jan. 31, 1958 was not always an easy task. As most of you will recall, when General Medaris and Dr. von Braun got that long-awaited go-ahead to launch a satellite, they moved with a certain dispatch.

"Because of my job, however, 20 years ago tonight I was one of a great many people gathered in a small room in the Pentagon. There we could watch a screen projecting classified teletype reports on the progress of the countdown for Jupiter C missile 29 as they were received from the Army Ballistic Missile Agency here, and from General Medaris and others in the block house at the Cape. Dr. von Braun was with us in Washington, probably the last place in the world he wanted to be just then.

"It was a long night. The only thing we could do was sit and wait for the occasional messages. Some of us managed the waiting better than others. I remember watching Dr. von Braun from time to time. Here he was at one of the supreme moments of his life. I imagine all of us wondered what he was thinking.

"Whatever his thoughts about being ordered to Washington so he could be available for a press conference, if we succeeded, he kept them to himself. He was unfailingly courteous, as always, answering questions of Secretary Brucker, General Lemnitzer and the others.

"What I remembered most were Dr. von Braun's optimism and confidence throughout that long night. He knew we were going to succeed, but then he had a distinct advantage. Most of us were having some difficulty adjusting to the very idea of going into space. He had spent his whole adult life planning and working toward that moment.

"I suspect he would remind us tonight, as he did several times during that night 20 years ago, that orbiting the satellite was the result of a team effort. It bears remembering that when the United States badly needed to succeed, we did. There was a shared pride for all of us who had a part.

" 'We' covers a great many people. It certainly includes Dr. William Pickering, Dr. James Van Allen, and the men and women then working at Redstone, JPL (Jet Propulsion Laboratory) and the Cape. It includes many individuals on the Washington end of the project who steadfastly supported the Army space program over the years.

"There are several I want to mention specifically: Secretary Brucker, General Jim Gavin, who was then Chief of Research and Development at DA, and General John Daley, the Director of Special Weapons at DA and later the first commander, Combat Developments Command.

"These men had the vision to foresee the importance of space, and the determination to insure that the United States would be second to none in meeting the challenge of space.

"Thanks to the efforts of this team, the Army was able to respond to a Secretary of Defense directive to launch a satellite, in 84 days and at a cost of $3.5 million. The events of that night 20 years ago are a bright memory that endures for each of us, despite might-have-beens that went before and disappointments that followed.

"That night and the days immediately after, however, it was enough for most of us to know that we had met the Soviet challenge, shown the world that the United States also had the technology, the capability and the will to compete in space. The Soviet satellites that preceded ours shattered forever the comfortable dream of scientific and technical superiority.

"Seldom has a nation and its people had such a hard and valuable lesson at so small a price.

"Almost overlooked in the sheer national joy of having matched the Soviets in achievement, if not weight in orbit, was the point that our tiny satellite also did the scientific job it was designed to do. Scientists later hailed confirmation of the Van Allen radiation belts as the greatest single achievement of the International Geophysical Year.

"That was long after the thousands of letters and telegrams came pouring into the ABMA (Army Ballistic Missile Agency) and the Pentagon from all over the world. Many were eloquent messages from great men and women, but those that I remember were words of Americans from all walks of life, some signed by every member of the family, that simply said: 'Thank you.' "

(GEN Guthrie at this point turned to a tribute to the ABMA, the significance of Explorer I in setting the stage for the U.S. progressive conquest of space, and impact on acceleration of technology). He concluded:

"The Army today has changed greatly from what it was two decades ago. We are an organization in constant evolution. Events such as Explorer I have taught us we have nothing to fear from change—indeed we must change if we are to perform effectively our primary mission: the defense of the United States.

"If I could have one wish granted, it would be that we do all the things we must now do with the enthusiasm and genuine excitement that touched us all 20 years ago—and that made orbiting our first satellite not a job but an adventure.

"Finally, to General Medaris, Dr. Rees, to every man and woman who had a part in the events of 20 years ago tonight, the United States Army expresses heartfelt thanks for a job well done."

A Major Military Resource

(Continued from page 20)

characteristics such as extreme hardness, ultrathin, or microscopic dimensions.

- Processing of material in rapid motion such as the dynamic balancing of turbine blades.
- Processing of material in otherwise inaccessible locations such as the tuning by material evaporation of electronic components located in sealed glass containers.

These capabilities make possible the use of otherwise unworkable materials in shapes and forms previously considered either impossible or at least well beyond the scope of normal manufacturing techniques.

When considered in total, the wide variety of techniques, equipments and capabilities achievable by laser technology demonstrably represent a major national resource.

WILLIAM S. ALCOTT, a senior electronics engineer with the U.S. Army Foreign Science and Technology Center (FSTC), Charlottesville, VA, has been involved extensively with the analysis of worldwide developments in lasers and electro-optics since 1962. He did postgraduate work at Northeastern University where he received a BS degree in 1949.

Army Pilot Picked as Astronaut Candidate

MAJ Robert J. Stewart, a test pilot at the U.S. Army Aviation Engineering Flight Activity, Edwards AFB, CA, recently became the first U.S. Army astronaut candidate selected for NASA's Space Shuttle Flight Program.

MAJ Stewart and 21 other military and 14 civilian personnel were selected from among 8,079 applicants following a year-long recruiting drive. Six of the selectees are women and four represent minority groups.

Following two years of training and evaluation at the Johnson Space Center, Houston, TX, successful candidates will become astronauts and enter the Shuttle Training Program leading to selection of a flight crew.

Mission specialist astronauts will participate in space walks, perform special payload handling or maintenance operations and assist in experiments. Pilots will operate the Space Shuttle Orbiter, including flights and landings.

Reinforced Plastics in European Helicopters

By Gordon C. Alling Jr.

Interest in composite materials, and in particular reinforced plastics (RP), has been gathering a great deal of momentum in the last few years, as evidenced by the papers which have appeared in numerous publications worldwide, and the increasing annual production of reinforcing fibers.

The reasons for this growth are fairly well known. Composites exhibit excellent specific strength and specific modulus values, as shown in Figure 1. Reinforced plastics also demonstrate an improved capacity to withstand a severe fatigue environment, which makes these materials particularly inviting to the helicopter designer.

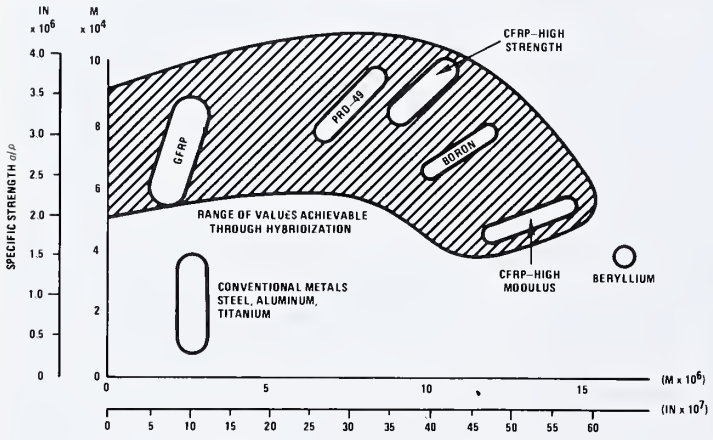


Fig. 1. Specific strength vs. modulus for composite materials.

Composites offer significant advantages in terms of cost. Presently, manufacturing costs are not lower but reduced life-cycle costs of some RP components have been clearly demonstrated.

Fatigue and damage tolerance qualities, for example, reduce periodic inspection and maintenance requirements as well as afford a long or infinite retirement life; also, many RP components can be resized to reduce aircraft empty weight or improve performance.

An example of this advantage is the French SA-330 Puma, which was originally equipped with aluminum main rotor blades and has recently been outfitted with composite blades. This change increased the maximum gross takeoff weight by 400 to 600 kilograms (Kg=2.2046 pounds).

Compared to the original gross weight, use of RP for the blades effected a 14 percent increase in the fast cruise speed and a 5 percent reduction in specific fuel consumption. All of these improvements caused a 13 percent decrease in the specific cost of transport ($/lb/mi), with the direct operating cost of the blades reduced to a third of the original.

Naturally, these advantages are achieved at some expense. Reinforced plastics are anisotropic, i.e., their strength is in only one direction. More critical, however, is the low capacity for these materials to transmit shear stresses. This weakness often necessitates the use of exotic and heavy joining techniques. European manufacturers, despite these weaknesses, have led the helicopter industry in applying composites. Companies such as Messerschmitt-Bolkow-Blohm (MBB) and Societe Nationale Industrielle Aerospatiale) have worked for years toward solutions of specific operational problems.

Because of their highly oriented loads, rotor blades became candidates for composite materials very early. In the early 1960s, a program sponsored by both MBB and Sud Aviation (now Aerospatiale) yielded the Bolkow blade (Figure 2), first flown on the BO-46 in January 1964. The blade concept entered production on the MBB BO-105 in 1968.

Fig. 2. BO-105 Main Rotor Blade

Today, both MBB and Aerospatiale use this concept on production aircraft. In addition to the German BO-105, the French SA-330 Puma, SA-341/342 Gazelle, and the SA-360/365 Dauphin helicopters all use similar main rotor blades consisting of long glass rovings - running continuously from the outboard tip, around bushings at the root, and back to the tip. This construction gives a continuous path for longitudinal loads.

All torsional loads are carried by the skin which covers the spar and trailing edge. MBB uses a glass fabric skin stabilized with a foam core in the trailing edge. Aerospatiale uses a graphite skin and a Nomex honeycomb core. The bushings at the root accept through bolts which attach the blade to the hub. The latest French helicopter, the AS-350, modifies this concept slightly. This all-glass blade uses a form-filled D spar with longitudinal rovings for spanwise loads and cross windings for torsional stiffness. The glass fabric trailing edge skin is also form-stabilized.

Tail rotor blades are also benefiting from these new materials. The BO-105 and the AS-350 have all-fiberglass tail rotors, and the MBB has experimented with carbon fiber/glass fiber hybrids to increase spanwise and torsional stiffness. Additionally, Aerospatiale is planning all-glass blades for the fenestron tail rotor on the Super Puma.

Rotor hubs also can benefit significantly from use of composites. Aerospatiale has demonstrated this fact with the Starflex rotor hub, shown in Figure 3, which has only 60 percent of the weight and less than 20 percent of the parts of a conventional, fully articulated hub.

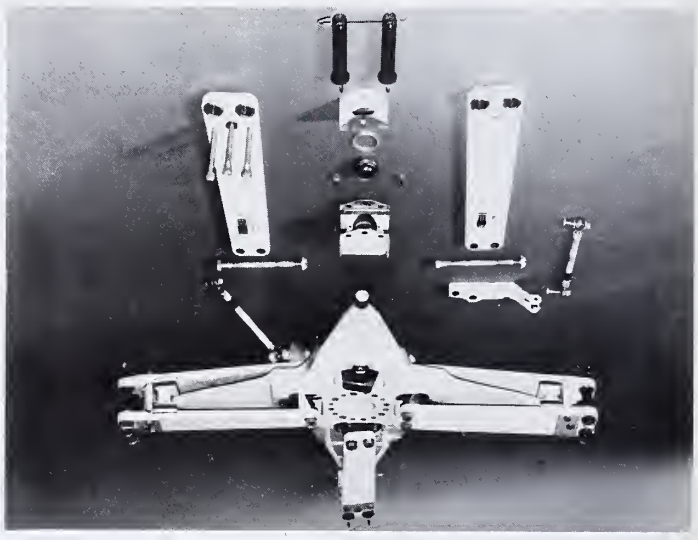


Fig. 3. Aerospatiale Starflex Rotor Head

Starflex employes S-glass-reinforced epoxy and elastomeric bearings to achieve a drastic simplification of the rotor head. The hub star, which carries torsional and bending loads, consists of a glass cloth laminate.

Centrifugal and bending forces are transmitted from the blades to the hub through two filament-wound connecting plates and a spherical elastomeric bearing while the in-plane drag loads are carried by the triangular star arms. Starflex will have no authorized TBO (time between overhaul) as it will be serviced on an "as required" basis. Many of these benefits can be attributed directly to the use of composites.

Finally, European manufacturers are experimenting with composites in primary structural components. MBB has reported on a program which developed a hybrid graphite/epoxy Kevlar/epoxy tail boom for the BO-105—a departure from generally accepted construction techniques.

The MMB tail boom consists of inner and outer shells of hoop-wound Kevlar encasing three layers of graphite filaments. The first and third graphite layers were wound at 8° to 12 ° and formed the bending shells.

The third layer was wound at 30° to 45°, forming the torsion shell; filaments are stacked along geodesic lines forming a net ("netsandwich") rather than a sheet. This concept gives the structure sufficient torsional strength while increasing bending stiffness.

Cutouts were reinforced with Kevlar fabric and tail pylon loads were introduced through two glass-fiber bulkheads bonded to the inside surface. The tail boom was tested to failure at 180 percent of the ultimate load and another unit was flight tested, yielding similar performance.

Component weight, however, was more than that of the production version - attributed to the cutout reinforcements and attachment hardware. The conclusion of testers was that a less conservative approach to these design problems would yield a real weight reduction.

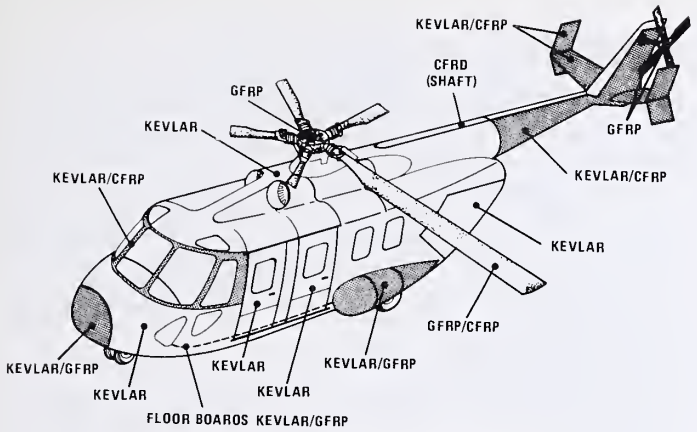


Fig. 4. MBB Concept for Composite Helicopter

European industry is intensely pursuing composites in an effort to increase helicopter efficiency. These materials are being proposed for both primary structure and dynamic components, including rotor blades, hubs, drive shafts and gears.

Figure 4 illustrates a concept for a reinforced plastic aircraft proposed by the MBB. It shows European industry is considering some very ambitious projects; further, that Europe is the forefront, if not leading the world, in the application of reinforced plastics in helicopters.

GORDON C. ALLING JR., an aerospace engineer working with the U.S. Army Foreign Science and Technology Center in Charlottesville, VA, has held this position since obtaining his BS from Virginia Tech in 1974. His work has fostered his interest in composite materials and has enabled him to keep abreast of foreign activities, as reported in a paper presented to the American Helicopter Society in November 1977.

Missile Materiel Readiness Command Mission, Capabilities

(Continued from page 18)

tracks the target, the sensor feeds course information into the computer, which then sends guidance over the wires to the missile.

A TOW subsystem used on helicopters is similar to the ground version, with two exceptions. The TOW helicopter configuration consists of two pods, each carrying four missiles; it features a stabilized sight that permits the gunner to hold a bead on the target, even while the pilot maneuvers to evade ground fire.

The first TOW unit in USAREUR (U.S. Army Europe) was equipped in November 1970. The Airborne TOW deployed in Vietnam became, in May 1972, the first American-made U.S. Army guided missile fired by U.S. soldiers in combat; along with its ground-to-ground counterpart, it performed "with great success" in 1972.

Lance, originally designated "Missile B," is a surface-to-surface ballistic system designed to replace the Honest John and Sergeant missiles in providing fire support to Army divisions. Complementing division tube artillery, it can also deliver a nuclear warhead.

Ground support equipment includes a Self-Propelled Launcher (SPL), a fully mobile Lightweight Launcher (LWL), and Loader- Transporter (LT). Lance has a newly modified inertial guidance and control concept that assures exceptional accuracy.

Termed "a highly mobile weapon system," Lance carries an 8-man crew and can traverse almost any terrain, using as its prime mover the M667 tracked vehicle. The firing unit is self-contained and self-sustaining on 2 M667s.

In airmobile operations, the lightweight launcher with missile can be carried into the battle zone by helicopter or fixed-wing aircraft. Lance was first delivered to U.S. troops in Europe in 1973.

MIRCOM also has a Special Systems Management Office that provides to using units and supports the following weapon systems:

• Nike-Hercules, a surface-to-surface missile system known as the United States' primary high-altitude air defense weapon in operational status, has proved successful against high-performance aircraft at a variety of altitudes.

The system became operational in 1958 and has successfully intercepted short-range ballistic missiles and other Nike Hercules missiles. Deployed in the United States and overseas, it is widely used by allies of the United States.

• Shillelagh is a lightweight, surface-to-surface guided missile system, designed as the main armament for armored combat vehicles. A direct-fire missile using a combination 152mm gun-launcher, Shillelagh is effective against tanks, troops and field fortifications. Missiles and conventional ammunition provide high accuracy against moving or stationary targets.

• Honest John, a simple, free-flight rocket, is designed to fire like conventional artillery in battlefield areas, and is the oldest missile system still fielded by the Department of Defense. It has the accuracy of standard artillery weapons, with substantially more battlefield mobility, and can deliver a nuclear warhead. Deployed in 1954, it has undergone improvements which have reduced weight, shortened gun tube length, and increased the firing range.

• Redeye is a man-portable, shoulder-fired weapon to provide combat troops in the forward battle area the capability of destroying low-flying aircraft. It is effective at ranges and altitudes commensurate with a close-in defense. Development has been funded jointly by the U.S. Army and the U.S. Marine Corps. Both services share in the output of production missiles.

An infrared sensing device in its nose (thus "Redeye") is used by the guidance system to "home in" on the heat of an aircraft engine.

The Special Systems Management Office controls the Land Combat Support System (LCSS). This multipurpose, automated system tests electronic guidance and control components of the Shillelagh, TOW, Dragon and Lance missiles.

The Aircraft Weapons Division of Special Systems has responsibility for the M22. This subsystem consists of boom assemblies on each side of a helicopter, with three missile launchers mounted on each boom. It is effective against armored vehicles and other hostile targets.

MIRCOM also has directorates for: Materiel Management; Maintenance and Engineering; Procurement and Production; Product Assurance; Management Information Systems; International Logistics; Personnel Training and Force Development. Remaining major components include the Targets Management Office (TMO), Kuwait Missile Systems Project Office, and the Metrology and Calibration Center.

The TMO is responsible for providing Air Defense Targets, associated equipment and flight services for Army Training and Air Defense Weapon System Test and Evaluation programs. The office is engaged in research and development, procurement and production, distribution, logistic support, and flight services.

TMO targets include the MQM-34D (Firebee), a high-speed subsonic target-guided missile; the BQM-34E/F supersonic Firebee and the AQM-37A supersonic target-guided missiles; also, the MQM-107 (Streaker), a variable-speed training target.

TMO also has the Ballistic Aerial Target System (BATS), the Low-Altitude Supersonic Target (LAST), and the High-Altitude Supersonic Target (HAST). Droned aircraft are the PQM-102 and the QF-86, along with the QH-50 helicopters.

The Kuwait Missile Systems Project Office manages the Foreign Military Sales (FMS) commitment to the government of Kuwait. It provides approved missile systems, equipment and services; appropriate technical assistance; individual and unit training; new equipment training; construction of facilities and appropriate follow-on supply support. Field offices are in Kuwait and in Jordan.

The Metrology and Calibration Center provides, in its functional area, Army-wide development and engineering support, technical control and direction, quality assurance, management and technical assistance, and insures logistics support; also, it provides liaison for world-wide U.S. Army metrology and calibration system operations.

The MCC maintains and operates the U.S. Army Standards Laboratory to assure outstanding measurement capabilities and calibration service; it also exercises technical control and direction over the Primary Nucleonics Lab.

In addition, the center exercises operational and technical control over the 95th Service Company (Calibration), and provides Redstone Arsenal with an Internal Calibration Facility that services MIRCOM, MIRADCOM and other authorized activities.

MIRCOM expended more than $550 million in FY77 and in FY78 is expected to spend over $570 million—most of it for procurement, research and development, operations, and maintenance. MIRCOM employs 5,500 civilians and 650 military personnel, most of them stationed at Redstone Arsenal. Some have duty stations at missile manufacturing plants, depots and with tactical units throughout the world.

MIRCOM works closely with many American industries. Prime contractors for its major weapon Systems are: for Chaparral, Aeronutronics Division of Ford; for HAWK, Raytheon Co.; for Dragon, McDonnell-Douglas Astronautics Co.; and for Lance, Vought Corp., Michigan Division. The systems integration contractor for Lance is LTV Aerospace Corp.

MIRCOM interfaces with other DARCOM elements, including the Armament Materiel Readiness Command, the Mobility Equipment Research and Development Command, and the Test and Evaluation Command.

Learning Your ABCs in Army Aircraft R&D

By Robert D. Powell Jr.

Engineers involved in discussing helicopter rotor research these days are concerned with ABCs and numerous other acronyms used to describe new rotor systems, some of which are still in their formative stage.

ABC stands for Advancing Blade Concept, designating a Sikorsky Aircraft Division program funded by the U.S. Army to evaluate the feasibility of the new concept. It involves two coaxial, counter-rotating, rigid rotors, 36 feet in diameter. Each rotor is composed of three blades and the aircraft, built by Sikorsky as a demonstrator, is referred to as XH-59A.

Some of its advantages are compactness, high control power, excellent hover efficiency, elimination of the antitorque rotor and high-speed capability. The Army has completed its program, which was directed toward the helicopter configuration, and is now participating in a joint Army/Navy/NASA program that will include investigations of the compound configuration in the high-speed regime (175 to 300 knots).

Another research rotor under investigation is the *A/AR* (Aero/Acoustic Rotor) — being developed to demonstrate the potential of new airfoil shapes and effects of advanced rotor tip shapes on acoustics, dynamics and blade loading. The A/AR is a candidate for test on the Rotor System Research Aircraft (RSRA) being developed by Sikorsky under a joint Army/NASA program.

The *BMR* (Bearingless Main Rotor) is a design which eliminates pitch bearings, flappings and lead/lag hinges. It uses a composite flexbeam hub assembly type construction to accommodate control system pitch inputs (through beam torsional deflection) and normal flapping motions (through beam bending).

Composites with the unique properties of high modulus fibers, and the elimination of bearings and hinges, will provide major advances in maintainability and reliability of helicopters. A program is under way with the Boeing Vertol Co. (BV) to evaluate the concept through flight test of the BMR on the B0105 helicopter.

The *CTR* (Controllable Twist Rotor) is a concept developed by Kaman Aerospace Corp. The design features a low torsional stiffness blade, a conventional swashplate, and a servo flap at three-quarters of the blade radius with an independent control which gives control over blade twist. In effect, the rotor features a dual control system.

These features provide improved performance, reduced vibration, reduced solidity, and upgraded survivability. Full-scale whirl tests and tunnel tests of H-43 full-scale blades, modified to accept the servo flap system, have been completed. The CTR full-scale model has the same chord, diameter, and solidity as the H-34 rotor, which was selected as standard.

Future plans include design and fabrication of new blades for evaluation through flight tests. The CTR is scheduled to be one of the advanced rotors to be flight tested on the Rotor System Research Aircraft. NASA Ames has also conducted full-scale wind tunnel tests of a multicyclic-control version of the CTR.

HER (High Energy Rotor) also is of considerable current interest. An OH-58 research aircraft incorporates existing blades with weights added to the tip sections of the blades to increase their inertia. These rotor blades will be evaluated by Bell Helicopter Textron (BHT) on the OH-58 through nap-of-the-earth (NOE) flight maneuvers such as bob-ups, pop-ups, and longitudinal and lateral accelerations.

Height-velocity boundaries and several flare techniques also will be explored in this effort. Advantages of the system are elimination of the "dead man's" curve, improved autorotation attitudes and safety, and increased hover agility.

HAR (Hover Agility Rotor) is being considered as a follow-on program to the HER, involving design, fabrication and flight evaluation of blades. of new blades.

TRAC (Telescoping Rotor Aircraft Concept) was developed by Sikorsky Aircraft as a new rotor system funded by the U.S. Army. The objective was to develop a variable-diameter rotor that would provide efficient hover, low downwash, and reduced noise at *low speeds;* also, reduced loads, vibration and gust sensitivity, and a smoother ride in forward flight at *higher speeds.* Small-scale model wind tunnel tests and limited full-scale component tests have been conducted.

RVR (Reverse Velocity Rotor) is a U.S. Navy program contracted to Fairchild Republic Co. This design included an articulated rotor with heavy rigid blades, cambered airfoil with a rounded trailing edge, and second harmonic feathering. Benefits of the double-ended airfoils would be less drag in reverse flow and thin-cambered sections having good performance at high Mach numbers.

The primary objective was to get the entire retreating blade in reverse flow to achieve a more uniform velocity distribution, thereby achieving a more uniform lift distribution. It was projected that the rotor would have a 300 knots forward flight plus a hover capability.

The *CCR* (Circulation Control Rotor) is another Navy advanced rotor blade program at Kaman Aerospace Corp. This program is funded by the Navy through flight test on the SH-2 aircraft. The CCR system eliminates cyclic pitch, thus avoiding the need for a swashplate.

Advantages projected are reduced vibration levels and improved performance. Rotor blade and hub are a hingeless configuration. Air supplied by a compressor is ejected tangentially out of a thin slot near the blade trailing edge, creating increased lift. Cyclic lift control is attained by modulating this airflow being ejected at the trailing edge.

The Cobra *IMRB* (Improved Main Rotor Blade) program is funded by the Army and performed by Kaman. Work has progressed to the Low Rate Initial Production (LRIP) phase.

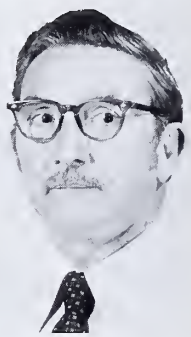
This improved main rotor blade was developed for the AH-1 helicopter to take advantage of new composite materials and advanced airfoils to improve performance, survivability, reliability and maintainability, and reduced costs. Flight tests have shown that the rotor has met or exceeded the majority of program technical objectives.

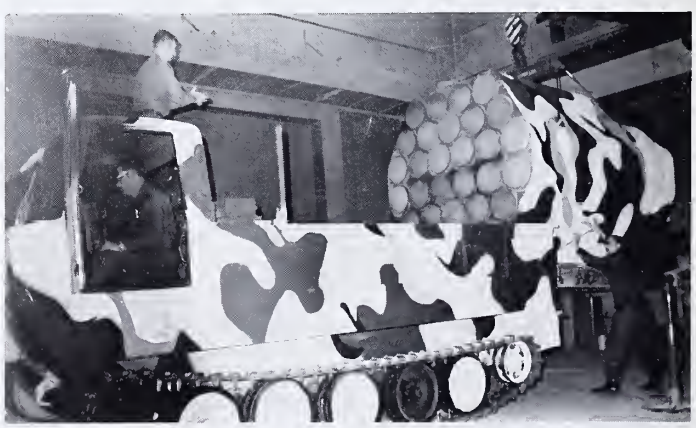
Rotor systems discussed in this article represent only a small sample of the new concepts being derived through new technology to improve helicopter performance, safety and survivability; reduce maintenance; extend life; reduce vibrations and curtail costs.

Many other concepts are being investigated, including BHT's Scissors Rotor and Flex Hinge Rotor; Sikorsky's Compliant Blade Rotor and Composite Structure Rotor; and Boeing Vertol's Live Twist Rotor.

One can be sure that, as technology is advanced, new analytical programs are developed, and new materials become available, the efforts to provide improved rotors will continue and, as one can guess, new acronyms will be invented.

ROBERT D. POWELL JR. is an aerospace engineer at Fort Eustis, VA, in the U.S. Army Research and Technology Laboratories headquartered at NASA/Ames Research Center, Moffett Field, CA. Presently he is lead engineer for the Advanced Rotor Technology Group in the Aeromechanics Office. He was an aerospace engineer in the Rotary Wing Section of NACA/NASA (1952-1958) and became an employe of what is now the Applied Technology Laboratory in 1958. Graduated from the University of Virginia in 1952 with a BME (Aero Option) degree, he has served as a U.S. Navy aviator.





SLUFAE (Surface-Launched Unit, Fuel-Air Explosive) launcher is loaded onto M–548 carrier for testing under extreme climatic conditions at the U.S. Army Cold Regions Test Center (CRTC), Fort Greely, AK. The SLUFAE (pronounced SLEW-FEE) launcher can fire single rounds or ripple fire all or any selected number of 30 rounds. The FAE rounds, which contain 85 pounds of propylene oxide, parachute to within a few feet of the target and explode, creating surface pressure that detonates mines on land or under water. See May-June 1976 and January-February 1975 issues of this magazine for SLUFAE development and capabilities articles.

Annual Listing of Highlight Articles in Army R&D Newsmagazine

Army Research and Development Newsmagazine articles during the past year believed of broadest interest to our readers are listed under their headlines as follows.

NOVEMBER-DECEMBER 1976—*16th Anniversary Edition.*

7th Annual Project Managers Conference Stresses Key Role of PMs in National Defense Materiel Development.

Speaking On: The Challenge to U.S. Army Program/Project Managers.

'Event Dice Throw' Climaxes DNA Nuclear Simulation Tests.

Explosives Technology Precision Likened to Scalpel Use in Study to Divert Lava Flow From City of Hilo in Hawaii.

Army RAG Viewed as Humane Civilian Riot Control Aid.

15th Annual Operations Research Symposium Directs Attention to Data for Decisions in Simpler Format.

Sheridan Product Improvement Places Emphasis on RAM.

USACSC Commander Discusses Technology Progress to Meet User Needs.

CDEC Upgrades Reliability in Collection of Field Data.

MARED Seminar Serves Goals of DARCOM Executive Development.

MICOM Metal Fibers Composite Wins Industrial Magazine Acclaim.

XV-15 STOL Aircraft Roll-Out Initiates Proof-of-Concept 2-Year Test.

MERADCOM Engineers Invent Zero-Current Circuit Breaker.

MICOM Awards $66.7 Million for Hellfire Missile D&E.

WSMR Installs DOAMS Telescope Prototype.

Reverse Osmosis Water Purifying Unit Enters Development Phase.

CRREL Team Participating in 10-Nation Glacial Ice Probe.

WSMR Reports Exceptional Accuracy With Laser-Aided Tracking System.

Representatives From 5 Countries Consider Mesometeorology Research.

R&D Associates Meet Cites 8 'High-Priority' Issues.

Army Scientific Advisory Panel Considers Soldier's Needs.

Alaska Northern Warfare Training Center Building Designed for Temperature to 75 Below F.

JANUARY-FEBRUARY—WSMR Vast Complex of Facilities, Sophisticated Equipment Serves Many U.S. Government Agencies.

Speaking On: Defense Posture Statements to Congress Focus on Need to Counter Rapid Advances in Soviet Weapon Systems.

Army Scientist Managing Federal Technology Transfer Consortium.

Army Closing Sturgis Nuclear Floating Power Plant.

$5.6 Million Allocated for Production of 200 Lightweight Doppler Navigation Systems.

Air Mobility R&D Laboratory Reports on Major 1976 Accomplishments.

Ware Simulation Center Completes Tests on 2 Weapons for Advanced Attack Helicopter.

Major R&D Materiel Acquisition Contracts Total More Than $716 Million.

Army Materials and Mechanics Research Center Tests Show 'Long Service' From Ceramic Bearings.

Improved Casting Methods May Lead to Increased Horsepower, Fuel Economy.

APG Dumped Tires Aid Ocean City Fishing Reef Project.

MERADCOM Traces Radioactive Eyepiece to Raw Materials Impurities.

Waterways Experiment Station System May Aid Dredged Material Disposal.

Bellows Attachment Eases Test Problems for Air Cushion Vehicle.

Mortar Artillery Radars (MALOR) Redesignated Firefinder.

MERADCOM Developing METRRA Mine Detector.

Soviet Nuclear Reactor Power Plants.

WSMR Optical Evaluation Facility.

NASA Officials View Shuttle Spaceflight Capabilities.

Aries I Instrumentation Collects Data at 200-Mile Altitude.

NASA Plans Year-Long Tests of Space Shuttle Orbiter.

NASA Funds Medical Spaceflight Shuttle Operations.

Developing Methodologies for Helicopter Analyses.

Alexander Sworn In as Secretary of the Army.

Brown Succeeds Rumsfeld as Defense Secretary.

Single Integrated Development Test Cycle Progress.

MARCH-APRIL—Walter Reed Army Institute of Research Activities in Many Lands Build Solid Base of World Renown.

Speaking On: Evaluation of Soviets' Over-all Threat: Analysis of Potential Factors.

Ballistic Research Laboratory Achievements Earn Army 1976 Top Award.

Slammer VI Shows Lethal Saturation Capabilities.

MERADCOM Expands Technical Support With EPA Noise Control Office.

Joint Logistics Commanders Charter New Fuze Management Organization.

New Weapon Station Adds Protection for TOW Gunner.

M110 Product Improvement Expected to Save Millions.

DARCOM Realignment Climaxes With ERADCOM, CORADCOM, CERCOM Decision.

HDL Fluidic Sensor May Yield Huge Fuel Oil Saving.

Joint Conventional Ammunition Group Claims 3-Year Billion Dollar Savings.

Video Instrumentation Credited With $800,000 Savings.

HDL Fuze Selected for General Support Rocket System.

Getting Sun Power Down to Earth.

BRL Achieves Improved Projectile Performance.

NATO's Tactical and Logistical Concepts Panel: Guide to Long-Range Research, Development and Engineering.

Utilizing Reliability in Materiel Acquisition.

Bridge Reinforcing Systems for the 1980s.

Perry Succeeds Currie as Director of Defense Research and Engineering.

White Sands Installs $9 Million Drone Formation Control System.

Patriot Interception of Drone Satisfies All Test Objectives.

Scientific Advisory Panel Meet Themed on Soldier's Armor.

60mm Lightweight Mortar Awaits Type Classification.

Army Announces Acceptance of Initial AH-1S Cobra.

WRAIR Reports 'Artificial Skin' Succeeds in Animal Wound Tests.

4 Van-Mounted Instrument TV Units Undergo Acceptance Tests at WSMR.

USAIR Provides Assistance to Tanerife Crash Victims.

ALMC Library Redesignated as The Army Logistics Library.

NBS, Battelle Labs Corrosion Study Nears Completion.

Joint Interface Test Force Established at Fort Monmouth.

MAY-JULY—Atlanta IV Seminar Deals With Improving Army-Industry Defense Effort.

Speaking On: Communicating for Public Understanding of Defense Problems. Also: A New Direction in the Acquisition Process.

National Junior Science and Humanities Symposium Supported by Army, Academia, Industry.

Manpack Radio Tactical Satellite Communications Demonstrated.

DARCOM Cites Industrial Firms at Atlanta IV Seminar.

WRAMC Investigators Report Leukemia Research Results.

White Sands Tests Demonstrate Patriot, Hawk Compatibility.

Test Pilot Terms XV-15 Aircraft 'Most Impressive.

New OBTVR Office Manages DARCOM CM/CCM Programs.

BRL Disbands 37-Year Scientific Advisory Committee.

TESTFACS Register Aids DARCOM SIDTC Program Requirements.

Mobility Equipment R&D Command Plans FAMECE Prototype Tests.

Army Type Classifies Improved Universal Engineer Tractor.

BRLESC Computer Gives Way to New Central Site Facility.

Natick Studies Enzymatic Conversion of Cellulose Reduced Cost Feasibility.

Black Brant Rocket Photographs Coma Galaxy X-Ray Emissions.

Advanced Concepts Team Responds to Innovative Industry Proposals.

WSMR Tests Experimetal Photovoltaic Energy Source.

Natick R&D Command Reports on 1976 Food Science Laboratory Research.

Test Reports Show Favorable Response to Personnel Armor.

Test Generator Development May Lead to Safer Jet Aircraft.

ABMDC Initiates 2-Phase Homing Overlay Experiment.

101st Airborne Division 'Volunteers' Trim AN-TRQ 32.

TARADCOM Conducts Durability Tests of Improved TOW.

Nuclear Meter Technique May Reduce Preventive Maintenance Costs.

Army Receives First Improved Chaparral Missile.

BRL Aids NBS to Combat Contamination.

TECOM Updating Test Resource Management System Capabilities.

U.S., NATO Test High-Speed Army Digital Tropo Modem.

WSMR Completes 4th Space Processing Applications Launch.

New TECOM Mission Includes Foreign Weapons Evaluation.

Army Judges Select 22 ISEF Winners for Summer Jobs, Trips Abroad.

Defense Officials Attend Advanced Planning Briefing For Industry.

Crux of Critical Problem: How Much Materiel Testing Is Enough?

19th International Mathematical Olympiad . . . U.S. Team Wins.

MARED Selectee List Evidences High Caliber of DARCOM Potential Managers.

Smoke/Obscurants Joint Effort . . . Army PM Draws Views of Other Services.

Dr. Pierre Sworn In as Assistant Secretary (RDA).

GEN Guthrie Calls for DARCOM Dedicated Team Effort.

Army/Marine Corps MOA Calls for Artillery BCS.

Computer Patterns Help Uniform Designers.

AUGUST-SEPTEMBER—Armament Materiel Readiness Command Serves Impressively Large Role in National Defense Structure.

ARRADCOM Mission Firepower Through Advanced Technology.

Speaking On: Major Thrusts for Increasing Reliability of Electronics Materiel.

R&D Achievement Awards Recognize Work of 63 Army In-House Scientists, Engineers.

Portable Dispenser Eyed as MP Riot Control Aid.

Chesapeake Hydraulic Model Earns National Acclaim.

$3.5 Million Contract Funds ABC High-Speed Flight Tests.

Communications Center Links HQ DARCOM, APG Computers.

Demilitarization Ensemble May Improve Protection From Hazardous Chemicals.

MERADCOM, ERDA Testing 4 Battery-Powered Vehicles.

Army Supports $334 Million Coal Conversion Project.

HDL Reports High Reliability With M734 Multi-Option Fuze.

TARCOM Allocates $252 Million for Heavy Trucks.

Project Indocom Supports Economic Growth Through Modern Communications.

Aberdeen Proving Ground Climatic Chambers Control Weather for Tests.

Materiel Product Improvement Program.

Sentinel Radar Eyed for Industrial Security Use.

New Aircraft Batteries Eliminate In-Flight Overheating.

NAS Documents Safety of Navy Seafarer Elf Research.

Contractor Support Alternative for Simulation Programs.

Information Computers Serve All Active Army Divisions.

White Sands Aids Los Alamos on Plutonium Plant Problem.

ARRADCOM Mission: Superior Firepower Through Advanced Technology.

TARADCOM Developing Multiplex Wiring System for Combat Vehicles.

Direct Logistical Support—New Eyes and Ears for DARCOM.

Transient Analysis, Electromagnetic Interference Studies.

AutoMicrobic System Aids Infections Diagnosis.

WES Hosts 4-Day Subsurface Cavities Symposium.

MOBA Conference Themes Urban Warfare Environment.

Commercial Construction Equipment in Noncombat Support Roles.

OCTOBER-NOVEMBER—Walter Reed Army Medical Center Dedication Climaxes Decade of Intense Effort to Attain Maximum in Advances.

Speaking On: Changing Army Operations Research.

Army Operations Research Symposium Themes Support of the Army of the 1980s—Looking Ahead.

Molecular Sieve Oxygen Generator Undergoes Tests.

Integrated Mockup Review Reports on AAH Status.

Thermal Target Tests Termed 'Overwhelmingly Successful.'

M60A1 Tanks Use British Smoke Protection System.

U.S. Army Armament Research and Development Command Continues SADARM Exploratory Development.

Cold Regions Test Center Examines Solar Panels for Endurance.

Patton Tanks Revamped for Copperhead Target Duty.

Tank-Automotive R&D Command Develops Gun Loader Trainer Device.

Patriot Componetry Intercepts Full-Sized Drone Jet Aircraft.

Bioengineering R&D Laboratory Mission Covers Multi-Disciplined Tri-Service Range of Activities.

Army Materiel Systems Analysis Activity Goal: Materiel Worthiness Through Quality Evaluation.

Army Authorizes Production of 56 More Black Hawk Copters.

Balloon Probes Collect Ozone, Stratosphere Data.

Army Materials and Mechanics Research Center Installs Hot-Corrosion Test Rig.

Army Air Mobility R&D Laboratory Renamed Research and Technology Laboratories.

Ceramic Cracks Laid to Electron Tube Failure.

23d Annual AUSA Meeting Focuses on 'Total Army' Readiness Requirements.

Army Modernization Affordability.

Top Army Leaders Accent Important Role of PMs in Defense.

2 Firms Chosen for Division Air-Defense Gun Engineering.

A Versatile Facility for Studying Fluid Flow.

4 MERADCOM Employes Win 20th Commander's Awards.

Eisenhart Receives 1977 Wilks Memorial Award.

Army Handicapped Employe of the Year Earns Esteem for 'Unyielding Devotion to Others.'

Grinding Process Wins Industrial Research Magazine Acclaim.

Chronic Pain Causes, Treatment Probed at Walter Reed Army Medical Center.

Armed Forces Communications and Electronics Association Conferees Review Military Communications.

Keith Wearing 3-Star Rank as Acting Deputy Chief of Staff for Research, Development, and Acquisition.

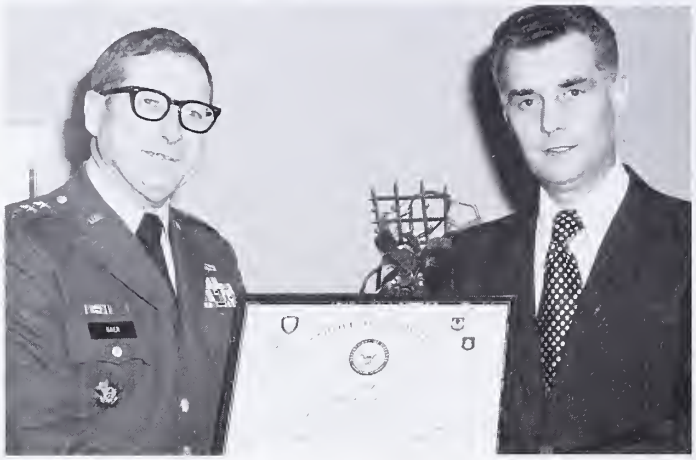
Pixley Takes Over as Army Surgeon General.

The Role of Reliability, Availability, Maintainability and Testing in Training Device Acquisition.

Laser Hazards: A Vital Army Research Program.

Awards...

Mlodozeniec Earns JLC Special Recognition



DARCOM DCG for Materiel Development LTG Robert J. Baer presents Certificate of Merit to Henry S. Mlodozeniec for service as chairman, Joint Logistics Commanders Panel on Design to Cost.

Achievements resulting in "significant benefits to U.S. Department of Defense design-to-cost contract procedures" have earned special recognition for Henry S. Mlodozeniec, U.S. Army Materiel Development and Readiness Command.

Mlodozeniec was recently presented a DARCOM/Naval Material Command/Air Force Logistics Command/Air Force Systems Command Certificate of Merit for May 1976 to October 1977 service as chairman of the Joint Logistics Commanders Panel on Design to Cost.

The panel was organized at the request of the Assistant Secretary of Defense (Installations and Logistics) to provide a "Uniform Design to Cost Status Report" during the development phase for the contracts containing DTC provisions. Its report has been approved by the Joint Logistics Commanders as a "guiding model for tracking all DTC contracts."

The award citation credits Mlodozeniec's "vigorous efforts, skill, knowledge and leadership." Since mid-1976 he has served as Value Engineering program manager in DARCOM's Office of Manufacturing Technology.

DARCOM Personnel Receive Meritorious Awards

Charles E. Riley | Larry Franzoi | Mason C. Linn

Damon E. Eckles | Winnie D. Reece | John T. Larizzio

Nine personnel of the U.S. Army Materiel Development and Readiness Command are recent recipients of the Decoration for Meritorious Civilian Service, the Army's second highest civilian employe award.

Charles E. Riley, a supervisory aerospace engineer at the U.S. Army Missile Research and Development Command, Redstone Arsenal, AL, received the award for conceiving, planning, and organizing MIRADCOM's Advanced Systems Development and Manufacturing Technology Directorate. His award justification states his efforts may result in shortened lead time required to develop missile and rocket systems and components, and improvements in quality and reliability at substantial cost savings.

Larry Franzoi, was honored for 1967-77 exceptional performance of duty as director, Program Management Division, Office of the Project Manager, Utility Tactical Transport Aircraft System (since redesignated Black Hawk), St. Louis, MO.

Franzoi was cited for "timely staff actions which avoided significant cost overruns, accuracy and strict adherence to work requirements, and innovative approaches" resulting in savings of about $600,000.

Mason C. Linn, an executive assistant at Tobyhanna Army Depot, PA, was recognized for a special duty assignment (1976-77) as acting chief of staff, HQ U.S. Army Depot Systems Command, Chambersburg, PA.

Linn was cited for "brilliant contributions" directly associated with activation of the new DESCOM. Responsibilities included management of 12 CONUS depots, 5 CONUS depot activities, 2 maintenance plants in Europe, and annual expenditures of more than a billion dollars.

Damon E. Eckles, public affairs officer, Sacramento (CA) Army Depot, was cited for "sustained professional ability and unequaled dedication relative to development of a balanced command public information and community relations program over a 9-year period."

Winnie D. Reece, writer-editor in the Public Affairs Office, Red River Army Depot, Texarkana, TX, was recognized for exceptional performance in planning, coordinating and conducting the PAO program.

John T. Larizzio, a forklift operator at Tobyhanna Army Depot, PA, received the MCSA for "swift and intelligent action" in administering first aid to save the life of a choking victim.

David A. Cessna, Bruce A. Fry, and *Don L. Hayes,* property disposal specialist instructors at the U.S. Army Logistics Management Center, Fort Lee, VA, were recognized for saving a 72-year-old man's life by rescuing him from a burning house.

Awards Cite Achievements of 6 HDL Personnel

Six personnel of the U.S. Army Harry Diamond Laboratories, Adelphi, MD, are recent recipients of annual awards presented for technical and managerial achievements.

Frederic W. Balicki, a physicist, was presented the 1977 William S. Hinman Award for technical leadership. He was cited specifically for direction of an Army technology transfer project which accelerates information exchanges among R&D laboratories.

"His guidance," the citation states, "provided significant impetus and expertise without which the program could not have been completed as expeditiously and successfully." The Hinman Award honors HDL's first technical director.

Dr. Norman J. Berg, a research physicist, received the Hinman Award for technical achievement. He was recognized for contributions in signal processing research which have resulted in a number of pending patent applications.

Group leader of HDL's Acousto-Optics Signal Processing Group, Dr. Berg has a degree from the Rabbinical College of Montreal, Canada, bachelor's and master's degrees from the Illinois Institute of Technology, and a PhD from the University of Maryland.

Stuart M. Marcus, A physical scientist, won the (COL) John A. Ulrich (first HDL commander) Award for managerial achievement. He was praised for his expertise in providing solutions to facility utilization and personnel resource problems.

A graduate of Brooklyn College, he has a master's degree in engineering administration from George Washington University and has completed requirements at the Armed Forces Staff College.

Gary K. Johnston, a contract specialist, received the Ulrich Award for managerial leadership. His successful procurement direction of a major military R&D program reportedly resulted in substantial monetary savings for the U.S. Army.

Frank Reggia, an electronics engineer assigned to the Microwave Branch, is the 1977 recipient of HDL's Inventor of the Year Award, honoring an individual who has been issued one or more significant patents during the preceding year.

Reggia was selected for his contributions and inventions in the field of microwave acoustics. He was individually issued one patent and jointly awarded three patents, and has authored or coauthored 45 tech reports.

A recognized expert on microwave antennas, he has BS (cum laude) and MS degrees in electrical engineering from Bucknell University. He is a 1976 recipient of one of the prestigious Department of the Army R&D Achievement Awards. Listed in *Who's Who in the East* (1975-76) and *Men of Achievement* (1976), Reggia is a member of the Institute of Electrical and Electronics Engineers, Academy of Science, and the American

Association for the Advancement of Science.

Dr. Carl Campagnuolo, an HDL research physicist for 16 years and a 1976 recipient of an Army R&D Achievement Award, recently received a Meritorious Civilian Service Award, the Department of the Army's second highest honor for civilian employes.

He was cited specifically for innovative design and development of air-driven and man-operated power sources which resulted in major military and civilian technological applications.

Selected as HDL's 1973 Inventor of the Year, Dr. Campagnuolo is a graduate of Brooklyn College with a master's degree from Georgetown University and a PhD from Catholic University. He has 45 patents.

Microbiologist Earns Award for Spore Research

Dr. Hillel S. Levinson

Achievements in spore research over a 25-year period earned Dr. Hillel S. Levinson of the U.S. Army Natick (MA) R&D Command a special award during the 7th International Spores Conference at the University of Wisconsin, Madison.

A research microbiologist, Dr. Levinson was cited specifically for pioneering studies on spores of the Bacillus megaterium QM B1551 microorganism, which has become important in worldwide research.

Graduated from the College of the City of New York, he earned a PhD degree from the University of Pennsylvania School of Medicine, and is an adjunct professor of biology at Northeastern University. He began his research on bacterial spores at the Army Quartermaster Research Center.

Dr. Levinson has authored more than 80 publications, is a member of the American Academy of Microbiology, American Society for Microbiology, New York Academy of Sciences, and the Society of the Sigma Xi.

Natick Man Chairs Chemical Society Division

Dr. Derek H. Ball

Research achievements in sugar and carbohydrate chemistry and technology have earned Dr. Derek H. Ball, Army Natick (MA) R&D Command, election as 1977 chairman of the American Chemical Society's Division of Carbohydrate Chemistry.

Employed at NARADCOM since 1960, Dr. Ball is assigned to the Food Chemistry Group, Food Sciences Laboratory. He has a BS degree (with honors) from Bristol University, England, and a PhD from Queen's University, Canada.

His previous honors have included a post-doctoral fellowship award from the National Research Council of Canada; a research fellowship at Alfred University, NY; and a 1967 Secretary of the Army Research and Study (SARS) Fellowship at Bristol University.

Dr. Ball has authored articles in more than 31 technical journals. He is a member of the Chemical Society of London, National Academy of Science, and the National Research Council.

The American Chemical Society is the principal technical organization of the chemistry profession. Its Division of Carbohydrates alone boasts a membership of more than 600.

BRL Mechanical Engineer Wins 1977 Kent Award

Donald F. Menne

Achievements in design, development and evaluation of the XM1 tank have rewarded Donald F. Menne as recipient of the 1977 Kent Award of the U.S. Army Ballistic Research Laboratory, Aberdeen PG, MD.

Established in 1957 to honor the memory of the late Robert Harrington Kent, the award (wall plaque, lapel pin and a Certificate of Achievement) is regarded as the most prestigious honor presented by the BRL in recognition of outstanding performance in science or engineering.

A mechanical engineer in BRL's Ballistic Modeling Division, Menne was cited specifically for "technical direction and innovations in armor design, ammunition stowage concept, and vulnerability reduction."

Responsible for coordinating all BRL armor and armaments efforts, he is now organizing a vulnerability methodology team to develop new tools for evaluating armored vehicles and lethality of antiarmor munitions.

Menne joined BRL in 1951 as a member of the Army Scientific and Professional Program for Enlisted Personnel. During 1956-66 he was an associate of internationally renowned geodesist and former Kent Award recipient Dr. Helmet Schmid.

Both were recognized for their research on electronic and optical instrumentation and for development of an aerial camera that served as a prototype for later military reconnaissance cameras.

Earlier work by Menne included image correlation research for missile guidance and pattern recognition for target acquisition, and technology in support of the Army's Cannon Launched Guided Projectile (Copperhead).

Graduated with a BS degree in mechanical engineering from Bradley University in 1950, he has done graduate work at the University of Delaware and Massachusetts Institute of Technology. He was also a Fellow at MIT's Center for Advanced Engineering.

CERL Researcher Receives Patent for Door Sealer

An invention that seals the doors of electromagnetically shielded rooms has earned a patent for Ray G. McCormack, a principle investigator with the U.S. Army Construction Engineering Research Laboratory.

Shielding is used in such facilities as communication centers and missile site control rooms to keep unwanted electromagnetic transmissions or interference from moving in or out. To be effective, these rooms should be fully sealed with no openings through which the transmissions could pass. Doors are particularly hard to seal on a continuing basis.

McCormack's patent, which grew out of his work in the Electrical-Mechanical Branch, is for an inflatable gasket with an electrically conductive coating. When inflated, the gasket makes full electrical contact between the door and the frame, providing electromagnetic shielding.

The invention and patent have been assigned to the U.S. Government.

Suggestion Earns RTL Woman Commendation, $295

Kathy Thomas received an oversize check for $295 from Beverley McDaris, Suggestion Program coordinator, U.S. Army Research and Technology Laboratories (RTL).

Ms. Thomas, secretary to George K. Merchant, chief, Policy, Plans and Programs Office, RTL, suggested that travel advance funds to laboratories personnel be disbursed from the Navy at Moffett Field, CA, rather than from the Presidio, San Francisco, 50 miles away, resulting in estimated annual savings of $4,865.

The commendation was signed by Dr. Richard M. Carlson, director of the laboratories, and was presented by COL John B. Fitch, deputy director, during ceremonies at the RTL Headquarters, NASA Ames Research Center, Moffett Field, CA.

Formerly known as the Army Air Mobility R&D Laboratory, RTL is the laboratory capability of the U.S. Army Aviation Research and Development Command (AVRADCOM), St. Louis, MO.

35-YEAR LENGTH OF SERVICE CERTIFICATES were presented recently to U.S. Army Materiel Development and Readiness Command employes by GEN John R. Guthrie, DARCOM commander. Recipients are (front row, left to right) Camden M. Hizer Jr., Edna Minner, Halvor T. Darracott, James U. Roberts and Carl W. Letsen; second row, Leonard A. Berg, William K. Konze, James E. Vandivier, Paul E. Burns and Richard A. Illoway. Fannie C. Whitehead, also a recipient, is not pictured.

Conferences & Symposia . . .

Tri-Service MT Meet Stimulates Expanded Interest

Expanded participation by industry and non-Department of Defense agencies marked the ninth annual Tri-Service Manufacturing Technology Conference at Orlando, FL, hosted this year by the Army.

The Manufacturing Technology Program is recognized by the Department of Defense (DoD) as a key activity for translating technology develped through research and development into viable cost-effective production processes.

The conference culminates a series of sub-committee meetings, and provides a comprehensive forum for the exchange of information to improve the DoD materiel acquisition process.

U.S. Army Materiel Development and Readiness Command Deputy Commander for Materiel Development LTG Robert Baer delivered the keynote address. Opening remarks were made by William Levitt, deputy assistant director, Production Resources and Planning, Office, Director of Defense Research and Engineering.

Other Army representatives included John Blanchard, assistant deputy for Materiel Development, HQ DARCOM; LTG Eugene J. D'Ambrosio, DARCOM deputy commander for Materiel Readiness; and COL Newell E. Vinson, chief of DARCOM's Office of Manufacturing Technology.

"Overviews" of Manufacturing Technology was the topic of Louis Dittmar, director, Manufacturing Technology Program, U.S. Navy Material Command; and James Mattice, chief, Manufacturing Technology Division, U.S. Air Force Materials Laboratory.

Topics and chairmen of technical subcommittee "overviews" included: *Computer-Aided Design/Computer-Aided Manufacturing,* Dennis Wisnosky, U.S. Air Force Materials Laboratory (AFML); *Non-Metals,* Robert Tomashot, AFML; *Electronics,* Charles McBurney, U.S. Army Industrial Base Engineering Activity (IBEA); *Metals,* Gordon Ney, IBEA; *Inspection and Testing,* Edward Criscuolo, Naval Surface Weapons Center; and *Munitions,* James Pritchard, Office, DARCOM project manager for Munitions Production Base Modernization and Expansion.

Results of an entire day devoted to Industry/Subcommittee Technical Exchange and Technical Interface meetings, concluding with a featured dinner address by Commander of the USAF Systems Command GEN Lew Allen Jr., attested to growing industrial interest in the MT Program.

Increased representation by the National Aeronautics and Space Administration, and the National Center for Productivity and Quality of Working Life, also evidenced expanding interest outside the DoD in manufacturing technology programs.

Arrangements for the conference were made by the DARCOM Office of Manufacturing Technology, assisted by the U.S. Army Materials and Mechanics Research Center, Watertown, MA.

Natick Hosts Materiel Deterioration Conference

Representatives of the United States, Canadian and United Kingdom military services exchanged information on research progress in technical papers and discussions at the recent 26th annual conference of Microbiological Deterioration of Military Materiel.

Hosted by the U.S. Army Natick (MA) R&D Command, the 3-day meeting was chaired by Dr. Arthur M. Kaplan, chief of Natick's Biotechnology Group, Food Sciences Laboratory. Natick Deputy Technical Director for the Food Service Systems Program, Dr. Hamed El-Bisi, joined with him in introductory remarks.

Topics of "high priority" interest included Microbiology of Environmental Pollutants; Materials Problems; Weathering Degradation of Materials; Test Procedures; and Impact of Regulatory Agency Requirements on Materiel Acquisition. A final session reviewed the 6th Meeting of the Quadripartite Working Party on Induced and Natural Environmental Conditions.

Foreign participants among more than 40 attendees included Alan P. Brookshaw and Dr. Anthony Davis, Ministry of Defence, Great Britain; Dr. J. M. McAndless, Defence Research Establishment, Ottawa, Canada; Dr. David J. Carlsson and J. C. Cooney, National Research Council, Canada; and Dr. Richard G. Gillis, Defence R&D Attache, Australian Embassy, Washington, DC.

Engineers Review Recreation Research Program

Progress and future direction of the U.S. Army Corps of Engineers' Recreation Research Program themed a recent in-process review (IPR) at the U.S. Army Engineer Waterways Experiment Station (WES).

Attended by representatives from each of the Corps' 10 CONUS operating divisions, the meeting was devoted primarily to discussions of "high-priority" research areas, and methods for accomplishing research.

Management of the comprehensive research program, designed to improve outdoor recreation services on some 11 million acres of federal lands and water, was assigned to WES following a 1975 feasibility study by the Institute of Water Resources.

Key areas proposed for research by IPR conferees included new facilities design and their predicted use by the public, natural resource preservation, environmental problems, economic and social impact, costs, law enforcement and visitor safety.

Considerable discussion focused on establishment of a series of Recreation Research Demonstration Units (RRDU) as a means of providing a common data base for individual research projects. RRDUs were viewed as potential "outdoor laboratories" for operational research testing.

RRDUs may also assist adjacent colleges and universities which offer programs in natural resource management.

A problem expressed by many conferees was that of communication. Concern was voiced that information relative to shared problems in planning, design, construction, operation and maintenance is not adequately disseminated.

RECNOTES, an information exchange bulletin, will be published periodically at WES and circulated throughout the Corps. The announcement said it will include notes, reviews and upcoming events concerning recreation problems and research activities.

Information will also be transmitted by regulations, manuals, technical reports, and through meetings with WES researchers, representatives from the Office, Chief of Engineers, Corps' laboratories, and divisional field contacts.

Recreation Research Program information may be obtained from Dr. Adolph J. Anderson, study program manager, or economist William J. Hansen on Area Code 601-636-3111, extensions 3657 and 3724.

AMMRC Calls for Solid Mechanics Meet Papers

Theoretical and experimental papers keyed to "Case Studies on Structural Integrity and Reliability" are being solicited for presentation at the sixth biennial U.S. Army Symposium on Solid Mechanics.

Scheduled Oct. 3-5, 1978, in Cape Cod, MA, and sponsored by the U.S. Army Materials and Mechanics Research Center, the unclassified symposium is intended to improve effectiveness of mechanics research for the design of advanced military systems. U.S. citizens may attend.

Proposed papers must originate from in-house, contract researchers or designers for the U.S. Army, Navy, Air Force, or other government agencies. Abstracts of about 500 words, with illustrations, are required prior to Feb. 1, 1978. Emphasis should be on applications of solid mechanics for the solution of design and engineering problems, leading to improved integrity and reliability.

Additional information may be obtained by inquiry to Army Materials and Mechanics Research Center, ATTN: DRXMR-T (R. Morrissey), Watertown, MA 01272. Telephone (617) 923-3253 or Autovon 955-3253.

Chemical Lab Hosts First R&D Program Review

Research and development achievements considered "highly beneficial" to the U.S. Army material user community were reported during the first program review conference at the Chemical Systems Laboratory, Aberdeen (MD) Proving Ground.

More than 90 R&D representatives from the U.S. Army, Navy, Air Force and embassy staffs of the Quadripartite nations (U.S., Canada, Australia, United Kingdom) attended the 2-day meeting, a follow-on survey and report to the CSL annual technical conference held last spring.

Deputy Director of the U.S. Army Armament R&D Command BG David Einsel presented the keynote address. William J. Pribyl, a chemical engineer in CSL's Munitions Division, was program action officer.

CSL Deputy Director Dr. B. L. Harris is director of the R&D program review, now scheduled as an annual event.

TECOM Sponsors Environmental Quality Conference

Federal funding to aid in combating environmental problems at U.S. Army installations in need of assistance may be forthcoming under a program explained at a 3-day meeting at HQ Army Test and Evaluation Command (TECOM), Aberdeen Proving Ground, MD.

Bruce A. Hildebrand, deputy for Environmental Affairs, Office of the Assistant Secretary for Civil Works, discussed President Carter's Environmental Message of May 23, 1977. He stressed that it denotes new emphasis on enforcing existing EQC (Environmental Quality Control) requirements. Hildebrand said Army planners should push forward innovative efforts in identifying problem areas at their installations, and promoting activities for practicable approaches.

Barbara Blum, the Environmental Protection Agency's deputy administrator, has discussed this problem with the Office of Management and Budget, Hildebrand said, and finds OMB totally supportive of efforts to assure prompt compliance with EQC standards.

About 40 representatives attended the workshop sessions, including personnel from TECOM's nine installations and activities, the Army Ma-

teriel Development and Readiness Command (TECOM's parent command), the Army Forces Command (FORSCOM), HQ Department of the Army, and other Department of Defense agencies.

LTC Donald A. Barbour, command environmental coordinator, was moderator, and environmental scientist Ms. JoAnn Carroll was coordinator.

COL George F. Carroll, TECOM director for Plans and Programs, who supervises the EQC office, said the meeting was the second Environmental Quality Coordinator's Workshop TECOM has sponsored in four years. Because of increasing command interest, and the significant impact of recent and pending legislation relating to EQC matters, more frequent sessions are contemplated.

TECOM installations and activities occupy over four million acres.

Career Programs . . .

Day Chosen for CSL Executive Training Program

Sheldon E. Day, U.S. Army Chemical Systems Laboratory, Aberdeen (MD) Proving Ground, is the 25th civilian selectee for six months of training under CSL's technical executive development program.

During the first phase of his training program, Day will make surveys and conduct briefings for the Technical staff at the CSL. This will be followed by three months of management training at HQ U.S. Army Materiel Development and Readiness Command, Alexandria, VA.

Sheldon E. Day

Assigned to CSL's Physical Protection Division as a chemical engineer, Day works on decontamination equipment and clothing developments. He began his Federal Civil Service career in 1971, after serving two years of military service at APG. He joined the staff at Edgewood Arsenal (CSL's predecessor) in 1964.

His academic credentials include a 1961 bachelor's degree in chemical engineering from the University of Virginia, at Charlottesville, and graduate training in management and psychology.

Australian Begins 16-Month BRL Assignment

Under a scholarship project sponsored by the Australian Public Service for post-graduate studies, Dr. Alan Rye recently began a 16-month rotational assignment at the U.S. Army Ballistic Research Laboratory, Aberdeen (MD) Proving Ground.

During his tenure in each of BRL's four branches, Dr. Rye will conduct research in areas such as interior ballistic modeling, charge design methodology, and propellant technology. His first assignment is in the Applied Ballistics Branch and he hopes to work on small arms problems.

Dr. Alan Rye

Graduated with a PhD in chemistry from the University of Western Australia, Dr. Rye conducted ballistic and weapons research in Australia prior to his BRL assignment. His scholarship was awarded in recognition of his work in ballistics research.

Commenting on Australian and American research, he noted that in Australia guns and tanks are very often purchased or licensed from other countries, while propellants and projectiles are designed or modified by in-house laboratories.

One of Rye's first purchases in the U.S. was a bicycle. He is somewhat surprised to see Americans using cars to travel relatively short distances. "In Australia," he says, "one walks or rides a bicycle for short travel."

HSC Announces Emergency Medicine Program

Approval of a new emergency medicine residency program, believed to be the first of its kind in the military services, has been announced by the U.S. Army Health Services Command.

Scheduled to begin in July 1978, courses in the 2-year program will be taught initially at Brooke Army Medical Center, Fort Sam Houston, TX. Completion of a flexible or categorical internship in any primary care specialty is a prerequisite. MAJ (Dr.) Larry E. Slay, chief, General Medicine Service at Brooke, is program director.

Students will receive in-depth training and experience in all specialties and subspecialties of emergency medicine, including exposure to emergency room procedures, and rotational assignments among medical services of the other Armed Forces.

Eustis Offers Marlinespike Seamanship Course

Teaching U.S. Army personnel marlinespike seamanship—the handling and care of rope—might seem to be an exercise in futility since the Army is basically a ground-oriented force. However, the ancient art is quite alive at Fort Eustis, VA, and for good reason!

The U.S. Army actually has in its inventory hundreds of watercraft, ranging from seagoing to amphibious vessels. Wherever there are port operations, there is a demand for marlinespike seamen.

Fort Eustis Rigging Loft is the only nautical rigging school in the Army. The training is a supplement to the Army Transportation School's harborcraft seaman course and cargo operations specialist course. About 900 enlisted men and 150 officers are trained annually.

Frank Gomillion, a U.S. Navy veteran and course instructor, stresses that one of the most important aspects of seamanship is the mastery of rope and wire. Knot tying is usually the most mystifying to the novice.

Rigging Loft students receive a series of eight self-paced courses, beginning with basic marlinespike seamanship, care and characteristics of fibre line, and wire and basic knot tying.

Canvas repair instruction covers care and use, how to measure and sew various stitches, and use of tools. Canvas is used primarily for making covers for equipment, firepumps, winches or items exposed to weather.

Students are taught how to make fenders or large pads from woven rope. The fenders are placed on the sides of the ships to lessen the impact as the vessel makes contact with the dock or another vessel.

The course concludes with instruction in splicing wire, the use of block and tackle, and how to figure the weight capacity of given block and tackle setups. Officers are offered training in harbor craft operations.

Women in Army Science...

Kingman Credits Success to 'Good Supervisors'

Pat Kingman, a metallurgist at the U.S. Army Ballistic Research Laboratory, Aberdeen (MD) Proving Ground, credits much of her success leading to national recognition during two decades of federal career employment to "luck in having good supervisors."

Assigned to BRL's Solid Mechanics Branch, Kingman has repeatedly earned esteem for numerous scientific achievements relative to development of Army weapon systems.

In 1972, she was presented one of the annual Army R&D Achievement Awards for development of a theoretical and experimental approach and analysis. She was cited for improving fundamental understanding of superplastic alloys, their structure and reactions.

Her work in this area was credited with opening the door to "tailoring" of materials for use in ballistic areas, including shaped charges, fragmentation devices and kinetic energy penetrators.

She is also credited with major breakthroughs in solid-structure research, including experimental verification of the "perfect" structure of crystallites within a superplastic alloy. This involved use of X-ray topography to obtain the first experimental measurements of theoretical curves for X-ray absorption by "perfect crystals of high atomic number."

Additionally, she has been cited for providing the first experimental evidence of Lomar-Cottrell dislocation locks in plastically deformed metals. Potential application of this model is considered wide, ranging from gun tube failure to armor design.

"I am more than satisfied with my achievements as a metallurgist," Kingman says, "but I have been lucky because I have been fortunate to have supervisors who have evaluated my progress as an individual rather than as a woman. I have found that men relate to men and this is where women have a disadvantage . . . but my career has been governed by men who were independent thinkers."

Kingman began her career as a chemistry technician with the Baltimore (MD) Division of the Martin Co., while a student at Johns Hopkins University (JHU) Evening College. She earned a master's degree in engineering science from JHU in 1963 and joined BRL in 1965.

Selected as the 1973 Outstanding (Technical) Professional in the Baltimore Region by the Federal Executive Board, she has served as president, vice president, secretary and on the executive board of the Maryland Institute of Metals. Author or coauthor of more than a dozen scientific papers, she is a member of the American Crystallographic Association, American Society for Metals, and the American Institute of Mining, Metallurgical and Petroleum Engineers.

MIT Publication Details Federal Port Policies

Technological and legislative impacts relative to development and operation of U.S. ports are detailed in a new book titled *Federal Port Policy in the United States*, available from U.S. Government Printing Office.

Published by the Massachusetts Institute of Technology Press, this 371-page study report identifies federal agencies' policies that have impacted on port planning. Considered is improving the policy-making system.

Emphasis is directed to activities of Federal Environmental Organizations, U.S. Army Corps of Engineers, Maritime Administration, U.S. Coast Guard, Department of Transportation, state and local agencies.

A major point of the report is that traditional policy involving programs of federal agencies is not to disturb the competitive relationship among ports. Cited also is that modern technology and other factors have disrupted this policy.

Federal agencies may affect port competition through: allocation of funds for dredging or port facilities; implementation of existing regulations pertaining to the siting and operation of terminal facilities and vessel movements; and formulation of new policies or programs which directly or indirectly affect ports.

The authors contend that the Federal Government must acknowledge the administrative dilemma confronting the traditional approach to port policy. They state that it is necessary to establish a unified approach to planning and developxt, and evaluating future competitive impacts.

Relative to activities of the U.S. Army Corps of Engineers, the report notes that national environmental awareness has become a major factor. Traditional implementation of Corps programs has also been influenced by new technologies, advances in intermodel transportation, and uncertainties in determining standards for evaluating navigation projects.

Allocation of federal funds for dredging is another major factor expected to impact on future Corps programs. Dredging activities will take on greater significance because environmental regulations and inflation have increased operating costs. The Corps is said to be in the position of influencing allocation of limited funds relative to dredging requests. Within limitations, the Corps may either distribute it efforts over a large number of ports or be selective.

Since port development has regional and national impacts, the report concludes, the Corps should develop at least a regional approach in performing economic analyses of port dredging projects, and calculate benefits and costs of new investments.

Work on this book was performed under contract for the Office of University Research, U.S. Department of Transportation.

Authors are: Henry S. Marcus, associate professor of Marine Systems and chairman, Shipbuilding Management Program, MIT; James E. Short, MIT doctoral candidate in political science; John C. Kuypers, management analyst, Army Military Traffic Management Command; and Paul O. Roberts, professor of Civil Engineering and director, MIT Center for Transportation Studies.

Additional information may be obtained from: The MIT Press, Massachusetts Institute of Technology, Cambridge, MA 02142.

Research Institute Announces 6 New Publications

Personnel motivation and race relations are included among topics of six publications announced recently by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI).

Technical Report 76-A7, *Motivation, Satisfaction, and Morale in Army Careers: A Review of Theory and Measurement*, is the first of several projects to search for, develop, and redefine ways of measuring and understanding motivation, job satisfaction, and productivity of soldiers.

Resources used for this project included analysis of Herzberg's *Two-Factor Theory, Maslow's Need Hierarchy, Locke's Theory on Intentions and Goals*; also, publications such as the *American Journal of Sociology, Personnel Journal*, and *Sociometry*.

R&D Utilization Report 76-2, *Changes in Black and White Perceptions of the Army's Race Relations/Equal Opportunity Programs—1972 to 1974*, presents findings of a survey taken in 1972 and replicated in 1974 at 13 Army installations.

Responses from 2,246 white and 1,943 black enlisted personnel indicate that the Army's racial situation has improved significantly. Major areas of dissatisfaction for blacks were promotions and military justice.

Technical Report 77-A9, *Evaluation of Army Representation*, reports on the relationship between the personnel makeup of the Army and that of the civilian population in general. A selected bibliography is offered.

Technical Report 76-A6, *Implementation and Field Verification of an Individualized Performance-Oriented Military Police Basic Law Enforcement Course (MOS 95B20)*, reviews progress in developing a self- paced Basic Law Enforcement Course.

Conclusions show that performance-oriented training has a positive effect on the level of job preparedness; hard skill rather than soft skill subtasks are better targets for this type of training.

Research Report 1191, *Initial Validation of Realtrain With Army Combat Units in Europe*, evaluates data on a new method of small unit tactical training tested at four U.S. Army Europe sites.

Interviews and questionnaires from training participants revealed enthusiastic attitudes toward REALTRAIN effectiveness. The over-all program was praised for realism and learning opportunities.

Research Report 1192, *Realtrain Validation for Rifle Squads: Mission Accomplishment*, compares effectiveness of REALTRAIN (simulated) and conventional training for a field experiment with rifle squads.

Summary data show that REALTRAIN resulted in a higher percentage of mission accomplishment with fewer simulated combat "casualties" sustained, and more inflicted in both attack and defense maneuvers as compared to conventionally trained squads.

Battelle Reports on Community Energy Planning

Integrated Community Energy Systems Planning: A State-of-the-Art Report, a new publication of the Battelle Memorial Institute's Columbus (OH) Laboratories, is available upon request to that agency.

Authored by government and industry energy experts, the 280-page book provides information relative to how communities might reduce dependence on petroleum-based fuels while developing other resources.

Dr. Duane N. Sunderman, associate director for research at Battelle, reports that the new volume represents "one of the first public discussions of a community energy planning concept, and should be of great assistance to state, local, and regional officials."

Topics include community responsibilities, systems evaluation, industrial challenges and priorities, community and building design, emerging energy sources, human ingredients, and government-community aspects.

Additional information relative to this document may be obtained from Susan Armstrong, Battelle-Columbus, 505 King Ave., Columbus, OH 43201 or telephone 614-424-7769.

People in Perspective...

Hobby Demands Patience . . .

Redstone Man Searches for Rare Rock Samples

Prerequisites for pastime pleasures often entail rather large financial investments in tennis rackets, golf clubs, musical instruments and other equipment.

Thomas J. Stramiello, chief, Hawk Missile Fire Control and Ground Support Equipment Branch, Redstone Arsenal, AL, has a hobby in which his principal investment is patience—the will to keep searching for rare rocks.

As a "rock hound," he has filled a yard and basement with rocks that attest not only to his own but also to his wife's patience.

Stramiello has been a member of the Huntsville (AL) Gem and Mineral Society for seven years and is serving his second term as president. He estimates that about two-thirds of the members are Active Army or retired Redstone military or civilian personnel.

Rock hunting, he says, is naturally suited to these people since most of them are technically oriented from their work environment. Many military bases have lapidary shops in their crafts and hobbies department.

Stramiello has found that scientific aspects of his own work with the HAWK missile system and an engineering degree from the University of Tennessee have proved valuable assets for rock hunting.

During a recent TDY to the Middle East he picked up about 15 pounds of minerals in a road cut outside of Jerusalem. An abandoned nickel mine in Germany also yielded some interesting finds. His hunting is limited to "off-duty" time. Other opportunities for adding to his collection are provided by the Huntsville Gem and Mineral Society's annual rock and mineral show; also, an annual fund-raising auction for the American Federation of Mineralogical Societies Scholarship Fund.

"One of the positive aspects of rock hunting," says Stramiello, "is that it isn't just a young man's game. Older people, such as the 90-year-old man on our last field trip, often have more patience than the young."

Personnel Actions . .

Bergquist Becomes Resource Management Deputy

MG Robert L. Bergquist

MG Robert L. Bergquist, former commander of the U.S. Army Materiel Development and Readiness Command's Depot System Command, Chambersburg, PA, has been selected as DARCOM deputy commander for Resource Management.

A distinguished military graduate of Providence (RI) College, MG Bergquist has a 1969 master's degree in business administration from the University of Pennsylvania's Wharton School of Finance and Commerce. He has completed requirements of the Armed Forces Staff College, Ordnance Officer Course, and is a distinguished graduate of the Industrial College of the Armed Forces.

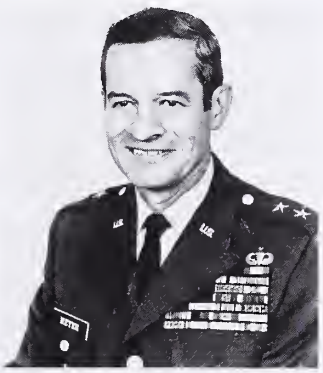
During 1973-76, he commanded Anniston (AL) Army Depot where he was credited with accelerating the tank rebuilding program; also, planning and executing the M48A1-A5 conversion program. He was assigned in 1969 as special assistant for Project Management, HQ Army Materiel Command (now HQ DARCOM).

MG Bergquist has served assignments in the Office, Army Chief of Staff, represented the U.S. in a cooperative automotive test program with the Belgian Armed Forces, and served in Vietnam. He also was an adviser to the Army of Thailand. He introduced new vehicles to U.S. forces in Korea and Germany and the Armaments Council of the North Atlantic Treaty Organization during 1959-62 service as project officer, M113 Vehicles, Ordnance Tank-Automotive Command, Warren, MI.

His military awards and decorations include the Legion of Merit with two Oak Leaf Clusters (OLC), and Commendation Medal w/3 OLCs.

Meyer Heads Ballistic Missile Defense Command

MG Stewart C. Meyer, former commander, U.S. Army Training and Doctrine Command Combined Arms Test Activity, Fort Hood, TX, is now commander, Army Ballistic Missile Defense Systems Command and manager, Army Ballistic Missile Defense Program.



MG Stewart C. Meyer

MG Meyer was director (1971-74) of Research, Development and Engineering at HQ U.S. Army Materiel Command (now DARCOM), following a 1970-71 tour as commander, XXIV Corps Artillery and chief of staff, XXIV Corps, U.S. Army, Vietnam.

Other key assignments have included military assistant to the deputy director for Tactical Warfare Programs, Directorate of Defense Research and Engineering, Office, Secretary of Defense; and deputy director, Missiles and Space, and exeutive officer, Office, Chief of R&D, HQ DA.

Graduated from the U.S. Military Academy, MG Meyer has a master's degree in mechanical engineering from the University of Michigan. His military schooling has included the Army War College, Command and General Staff College, Artillery School (advanced course), and FA (basic).

MG Meyer wears the Distinguished Service Medal, Silver Star, Legion of Merit with Oak Leaf Cluster (OLC), Bronze Star Medal with "V" device and five OLC, Air Medals, Army Commendation Medal with OLC, Purple Heart, and Senior Parachutist Badge.

Realignment of responsibilities for managing the nation's waterways—long a part of the Army Corps of Engineers massive Public Works Program—could involve a partial transfer to the Department of Transportation, under a recommendation of the Senate Governmental Affairs Committee and the President's Office of Management and Budget. This option has been announced for public comment and is expected to stimulate considerable controversy. A call to the Senate Committee resulted in: "No public hearings have been scheduled yet."

McCabe Takes Over Health Services Command

Command of the U.S. Army Health Services Command, headquartered at Fort Sam Houston, TX, was assumed by MG Marshall E. McCabe following retirement of MG Spurgeon Neel after more than 30 years military service.

MG Marshall E. McCabe

MG McCabe has served as commander, U.S. Army Medical Command, Europe and surgeon, U.S. Army, Europe. In 1973 he was selected as the first HSC chief of staff when that activity was established.

During 1970-73 he was deputy for Medical Corps Affairs, Office, Special Assistant to The Surgeon General for Medical Corps Affairs, Office, The Surgeon General, U.S. Army. This duty was preceded by a tour as deputy commander and chief, Professional Services, Letterman General Hospital, San Francisco, CA.

Another key assignment during more than 29 years of active military duty was chief, Medical Consultant Branch, Consultant Division, Directorate of Professional Services, Office, The Surgeon General, Department of the Army, Washington, DC.

MG McCabe has a BA degree in pre-medicine and an MD from New York University, and is a graduate of the Medical Field Service School (basic course). His military awards include the Legion of Merit with OLC, Meritorious Service Medal and Army Commendation Medal with OLC.

Fossum Follows Heilmeier as DARPA Director

Dr. Robert R. Fossum, dean of Research and dean of Science and Engineering at the U.S. Naval Postgraduate School since 1974, recently succeeded Dr. George H. Heilmeier as director of the Defense Advanced Research Projects Agency (DARPA).

Dr. Fossum was engaged in studies and analysis, hardware delivery and technical marketing as vice president and general manager of ESL Inc., Sunnyvale, CA. He has served as a research associate at Oregon State University and with Sylvania's Electronic Defense Laboratories, Mountain View, CA.

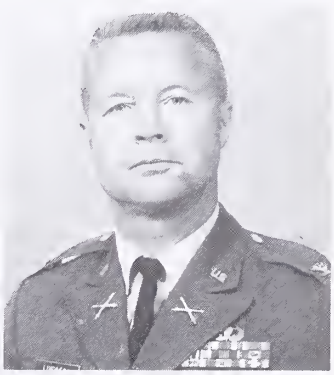
Graduated (Phi Beta Kappa) with a BS degree in mathematics from the University of Idaho in 1951, Dr. Fossum earned an MS degree from the University of Oregon in 1956, and a PhD in statistics from Oregon State University in 1969.

Author of numerous scientific and technical articles, he has served as an associate member of the Defense Intelligence Agency's Scientific Advisory Committee, and as an observer on the Defense Science Board's Net Technical Assessment Task Force.

Dr. Heilmeier resigned to join Texas Instruments Inc. as vice president of its newly established Systems Technology Laboratory, Dallas, TX.

Lueders Assigned as HELS Project Manager

COL Dirk H. Lueders has succeeded COL Vincent P. DeFatta as project manager for High Energy Laser Systems (HELS), U.S. Army Missile Research and Development Command, Redstone Arsenal, AL.



COL Dirk H. Lueders

Graduated from the U.S. Military Academy, COL Lueders has a master's degree in physics from the University of Virginia and a PhD in nuclear physics from Tulane University. A graduate of the Command and General Staff College, he has completed basic and advanced artillery courses and the Army Airborne School.

COL Lueders has served with the Defense Nuclear Agency, Army Nuclear and Chemical Agency, 1st Missile Battalion of the 33d Artillery, and 25th Infantry Division, Military Assistance Command, Vietnam.

His military honors include the Bronze Star Medal, Meritorious Service Medal, Air Medal, Army Commendation Medal, and the Vietnamese Gallantry Cross with Bronze Star.

(Continued on page 32)

Connell Picked as Military Construction Director

BG Richard M. Connell

BG Richard M. Connell will end a tour of duty as South Pacific Division engineer to take over Jan. 8 as director of Military Construction, U.S. Army Corps of Engineers, Washington, DC.

A 1949 graduate of the U.S. Military Academy, BG Connell has an MS degree in civil engineering from Massachusetts Institute of Technology. He has completed requirements at the Command and General Staff College, Army War College, Ground General School, and Engineer School.

BG Connell served as Walla Walla (WA) District engineer, 1970-73, following assignments in the Office, Assistant Vice Chief of Staff, Department of the Army, serving as chief, Force Authorizations Systems Team; chief, Management Systems Group, Force Planning Analysis Directorate; and in the Directorate of Planning and Programing Analysis.

A registered professional engineer in the District of Columbia and California, he is a recipient of the Legion of Merit with two Oak Leaf Clusters, Joint Service Commendation Medal, and Army Commendation Medal.

Davis Joins Communications Systems Agency

COL Francis J. Davis

COL Francis J. Davis is the new deputy commander/deputy project manager for the U.S. Army Communications Systems Agency/Project Manager (DCS) Army Communications Systems, Fort Monmouth, NJ.

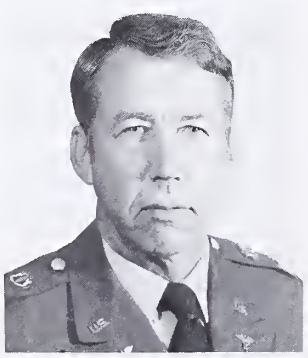
Until reassigned as successor to COL Charles N. Childers, COL Davis was systems manager for Automatic Test Support Systems, U.S. Army Training and Doctrine Command, Fort Gordon, GA. He served from November 1975 to June 1977 as commander, School Brigade, U.S. Army Signal School, relocated in 1976 from Fort Monmouth to Fort Gordon.

During 1974-75 he was acting associate director for D&E, Directorate for Research, Development and Engineering, HQ Army Electronics Command at Fort Monmouth, following duty there as special assistant to the PM and assistant PM/director, Plans, Programs and Analysis, Army Tactical Data Systems.

COL Davis has a BS degree in electrical engineering from Massachusetts Institute of Technology and an MS degree in electronics engineering from the University of Arizona. He is a graduate of the Command and General Staff College, and the Air War College.

His military honors include the Legion of Merit with three Oak Leaf Clusters, Soldiers Medal, Bronze Star Medal, and the Joint Service Commendation Medal.

Dettor Heads Medical Bioengineering Command



COL Charles M. Dettor

COL Charles M. Dettor is the new commander of the U.S. Army Medical Bioengineering Research and Development Command, Fort Detrick, Frederick, MD, following an assignment as MBRDC director of Army Systems.

Among his earlier tours of duty are: director, Environmental Quality Research, Army Medical R&D Command; assistant chief, Technical Support Division, Letterman Army Institute of Research; and chief, Nuclear Branch, Department of Nuclear, Biological and Chemical Sciences, Medical Service School.

COL Dettor has a BA degree in chemistry from the University of Mississippi, an MS degree in radiation biology from the University of Rochester, and a PhD in radiation biology from Colorado State University.

He is a recipient of the Meritorious Service Medal and the Army Commendation Medal.

Army R&D — 15 Years Ago

The Army R&D Newsmagazine reported on . . .

Defense Directive States Policies on Tech Info

Basic policy and a far-ranging concept for handling of technical information within the Department of Defense are stated in DoD Directive 5100.36, aimed at improving utilization of available R&D knowledge.

Instructions in a memorandum, addressed by Deputy Secretary of Defense Roswell Gilpatric, require all DoD agencies to complete, as a matter of priority, the inventory and analysis of their scientific and technical information activities.

Based on recommendations of an ad hoc group established by direction of the Chief of Research and Development, the Department of Army Scientific and Technical Information Program is expected to be submitted to the Secretary of the Army for decision early in 1963.

The new DoD Directive actually regulates two separate information programs, one dealing with scientific and technical information, the other with production engineering and logistics.

Director of Defense Research and Engineering Dr. Harold Brown is assigned over-all management control of the DoD Scientific and Technical Information Program. Assistant Secretary of Defense (I&L) Paul R. Ignatius is charged with responsibility for the Production Engineering and Logistics Information Program.

Army Regulation Stresses Materiel Reliability

Army-wide major emphasis on reliability of weapons systems and equipment during the research and development cycle is prescribed in Army Regulation 705-25, described as the first AR of its kind.

Based on DoD Instruction 3200.6, Reporting of Research, Development and Engineering Program Information, AR 705-25 incorporates policies and procedures set forth in a number of existing directives, memoranda and letters concerning reliability requirements and specifications.

The regulation specifies policies and responsibilities concerning reliability and details information to be included in R&D documents such as Qualitative Materiel Requirements, and Technical Development Plans.

Major commands and agencies representing the users of Army materiel and equipment are advised by AR 705-25 that factors critical to reliability design must be explicitly established and prescribed. Precise design parameters will serve also as the basis for incentive contracts.

SATCOM Prepares for SYNCOM Tests

The Army Satellite Communications Agency (SATCOM) will send signals through 22,300 miles of space to activate and test the National Aeronautics and Space Administration's SYNCOM satellite.

Scheduled for launching early in 1963, SYNCOM, under over-all NASA management, is being supported by the Department of Defense. It is the first U.S. synchronous orbital communications satellite, and is being developed by NASA's Goddard Space Flight Center through a contract with Hughes Aircraft Co.

SATCOM will test SYNCOM's capabilities as an active spatial communications relay point by sending signals from surface terminals. Located at Fort Monmouth, NJ, SATCOM is responsible for Army research, development, engineering, procurement and installation of the surface communications facilities for the Defense Communications Satellite System.

Materiel Leaders Discuss Standardization Program

U.S. Army Materiel Command (AMC) leaders discussed plans for conducting the standardization program at a conference at HQ Quartermaster Research and Engineering Command, Natick, MA.

AMC's Procurement and Production Directorate has been assigned standardization management for the Army. This brings together all the management functions previously assigned to the Army Standardization Office of the Army Technical Services.

The new organization brings the field standardization elements closer to the top echelon group. Responsibilities previously assigned to chiefs of the Technical Services are now delegated to the AMC field commands.

FY 1963 Federal R&D Funds May Hit $14.7 Billion

Research and development fund obligations are expected to total about $14.7 billion during FY 1963—an increase of $3.5 billion (31%) over the $11.2 billion R&D expenditure in FY 1962.

Data obtained in the 11th annual survey by the National Science Foundation in cooperation with other federal agencies show that $8.5 billion in FY 1963 is to be obligated for development and $4.5 billion for research. An estimated $1.6 billion is to go into R&D plants or facilities and $100 million for scientific and technical information.

Survey findings pointed to a continuous rise of the national investment in military, space and atomic energy programs, as well as to greater national support of programs concerned with health, welfare and resources.

Army Surmounts Many Environmental Problems With New Solar Station

By Dr. John W. Bond, William A. Rice and William Milway*

Potential application of solar energy to serve military requirements at remote instrument stations is being explored with a Solar Cell Electric Power System (SCEPS) on top of Goat Mountain, at an elevation of 6,638 feet in the San Andreas Mountain Range of New Mexico.

Located about 20 miles northwest of White Sands (NM) Missile Range Headquarters, the experimental station consists of a solar cell array capable of 1.6 kilowatts peak power, a 1.5-KW solid-state inverter and 1,500 ampere hours of storage capacity. The installation is the first SCEPS procured by the Department of Defense to provide alternating current for remote area test sites.

The effort described in this article is the initial phase of an instrumentation development project to explore and document the pros and cons of what solar power can do for instrumentation used by the U.S. Army Test and Evaluation Command, headquartered at Aberdeen Proving Ground, MD.

In November 1976, TECOM funded the U.S. Army Mobility Equipment Research and Development Command (MERADCOM), headquartered at Fort Belvoir, VA, to design, procure and install a solar cell electric power system at WSMR.

Known as Project D623 of the TECOM Instrumentation Development Program, its purpose is to improve efficiency of TECOM testing through use of new or unique instrumentation technology.

Solar power appears to offer a high potential for serving this goal. Earlier, solar power reference stations for a range measurement system were acquired under D623 sponsorship at Yuma (AZ) Proving Ground, where they have proved successful.

TECOM manages nine test activities including several large test ranges in remote areas of the west. They are instrumented heavily with telemetry, radar, optical devices and electronic ranging systems.

Many sites are at inaccessible locations lacking electric power or other improvements. Operation of test instruments at such locations is difficult and expensive.

The purpose of the SCEPS at WSMR is to provide electric power for one of the distance measuring equipment (DME) stations of the Drone Formation Control Systems (DFCS—CF Section 3).

The U.S. Army Atmospheric Science Laboratory (ASL) at WSMR cooperated in making relevant insolation and environmental measurements for the SCEPS installation. The DFCS/DME requires 750 watts electric (We) at 115 volts A.C. for a maximum of six hours during any 24 hours.

Installed in late August 1977, the Goat Mountain SCEPS provides power to one of six DME stations that support the DFCS in tracking and controlling multiple aerial targets throughout the 4,000-square mile area of WSMR.

The Goat Mountain site was selected in June 1977 when it was decided to relocate a ground station (known as Army II) installed in August 1975 on the WSMR valley floor at an elevation of about 4,000 feet.

*Dr. J. W. Bond is with the U.S. Army Mobility Equipment R&D Command, Fort Belvoir, VA. William A. Rice is chief, Drone Formation Control System, U.S. Army White Sands Missile Range, NM. William Milway is with the Army Test and Evaluation Command, Aberdeen Proving Ground, MD.

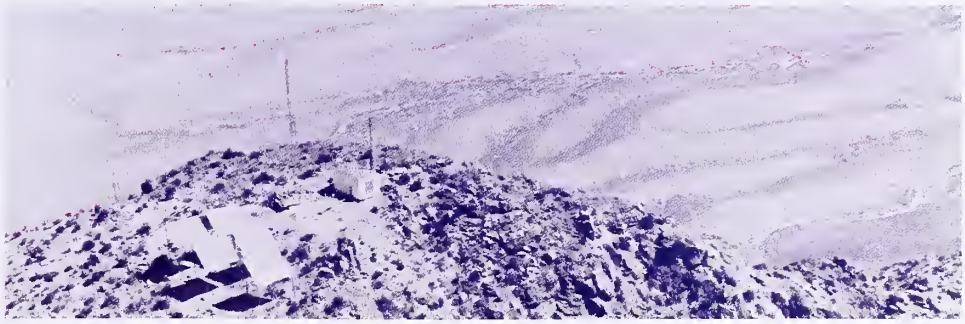


Fig. 1. Solar Cell Electric Power Station on Goat Mountain, NM.

The move to a higher elevation was made to alleviate signal-fading problems during developmental flights and hot-firing tests of the Patriot missile system for national defense.

However, the higher elevation of Goat Mountain placed the DME in an area subject to severe thunderstorms and high lightning strike incidence. Moreover, the high peaks in the southern part of WSMR, such as Goat Mountain, are characterized by sudden intense cloudiness. Severe wind gust-loading on the steep slopes is another complicating factor.

A 20-foot tower on Goat Mountain was severely damaged by lightning a few weeks before the SCEPS was installed, but the hazard of such strikes can be alleviated by lightning rods (towers) and adequate electric grounding.

Field effects from lightning (up to 10 miles distance from strike) can couple into large conductors (such as SCEPS) and cause damage to subsystem components such as solar cell interconnects.

Three of the other DME stations are located on mountain peaks surrounding WSMR. Another is a van-mounted mobile station for low-altitude coverage. The remaining station is located centrally, along with an IBM S360/75 computer, at WSMR HQ.

Criteria used in selecting sites for the DME stations include accessibility, availability of electric power and, most important, elevation—as location on mountain peaks enhances line-of-sight and reduces multipath signal-fading problems.

Accessibility, which was necessary for development and checkout, is no longer an important factor, since the stations have proven highly reliable over the past year. Power required at the DMEs remains a constraining factor.

Another complication encountered is that the site is inside the San Andreas National Game Refuge, inhabited by wild horses, deer and about 200 rare and protected desert bighorn sheep.

The latter are of particular concern because of their proclivity to jump on almost anything that stands up. Accordingly, the solar panels have been placed on 12-foot high metallic stilts* (see Figure 1). Cables are used to anchor the panels as protection against gust-loading.

These safeguards necessitate further protection against lightning strikes. Therefore, two 40-foot-high lightning rods have been erected; one serves the solar cell array, the other serves the DFCS/DME (Fig. 1).

A 6-foot square aluminum pan, about 6 inches deep, is filled with a brine solution to serve as a common electric ground. Since the animals like salt, numerous salt blocks are distributed at lower parts of the mountain to keep them away from the electric-ground brine solution.

*Fencing is banned because animals may be entrapped.

Further complications arise when the animals chew the cables used for remote power systems. Placing the cables inside plastic (PVC) solved this problem but raised another in that the remedy controverts lightning protection which requires metallic shielding of the cables. The problem is under investigation.

Another problem is that of thermal shock or sudden thermal phenomena. In the hot summer sun at WSMR, the solar cell panel may be heated to 140-170° F. Cooling to 60° F. could occur in a few minutes due to a thunderstorm. The resulting temperature gradient could be much higher than present specifications (3° F./min.).

During a thunderstorm, all of these damage phenomena— wind, gust-loading, lightning effects, and sudden thermal effects—could occur together, making monitoring of the SCEPS an important function.

The solar array consists of 5 panels, each containing 4 series strings, which are paralled together to produce a peak generating capacity of 1,600 watts. Storage consists of four 24-volt, lead-acid batteries connected in a series-parallel arrangement to provide a total storage capacity of 1,500 ampere-hours at 48 volts (see Figure 2). Each of the batteries weighs 1,600 pounds.

The inverter, which is actuated by a remotely controlled switch, provides up to 1,500 watts, single-phase power at 115 V a.c., 60 Hz to operate the main and auxiliary loads. A regulator provides 5 watts d.c. power at 12 volts for a standby receiver.

In the initial phase of SCEPS development, permission was granted for temporary location of a propane-powered generator at the Goat Mountain site. However, game management noise restrictions and the protected bighorn sheep make the MERADCOM solar unit the only acceptable long-range power source.

TECOM is confident that we can significantly increase our testing efficiency through utilization of solar power and plans to continue cooperative efforts with MERADCOM in providing additional solar power installations at Yuma (AZ) and Dugway (UT) Proving Grounds.

Fig. 2. SCEPS Storage Batteries

Why Should You Remember Jan. 31, 1958?

Millions of Americans Exulted Because of an Epochal Advance

Lest we forget, lest we forget ... What epochally important event, exuberantly hailed by millions of Americans, took place Jan. 31, 1958?

Memory fades in the minds of many after the passage of 20 years. In that span a whole new generation of Americans has grown up as the hope of the future for a progressive, prosperous nation at peace with the world.

Many of those who will assume the positions of prominence in the American way of life might be stumped for an answer to the significance of Jan. 31, 1958, and the role of defense in the cause for joyous celebration.

U.S. Army historians, however, have recorded that event as one of the nation's proudest moments for prestigious achievement. On that night of Jan. 31, at 10:48 EST, the Army's Jupiter C missile entered the U.S. into The Space Age with Explorer I, a satellite launched into Earth orbit.

That was the nation's response to the challenge of Russia's shocking surprise of Sputnik I as the world's first Earth satellite, Oct. 4, 1957.

Explorer I was launched just 84 days after the U.S. Army was given the go-ahead to proceed with a response to Sputnik I. Explorer I remained in orbit years longer than anticipated—until Mar. 31, 1970 when it dropped back into the atmosphere and burned upon reentry.

Judged by today's space standards, Explorer I was a "mighty midget." It carried only 10.6 pounds of scientific instrumentation and radios within its 6-inch diameter shell. From tip to tip it measured 80 inches and it weighed 30.8 pounds, far less than Sputnik I.

Still the U.S. Army Missile Command, successor to the Army Ballistic Missile Agency—formed by MG John B. Medaris in late 1955 with Dr. Werhner Von Braun as technical director—looks back on Explorer I as a most remarkable achievement. Dr. Von Braun had first proposed in 1954 that the U.S. Army Redstone ballistic missile be used to orbit an Earth satellite.

That proposal by the leader of the German World War II team that developed the world's first ballistic missile, the V-2 used to bomb London, won some support as a joint Army- Navy project. President Dwight Eisenhower, however, decided that another rocket, the civilian-developed Vanguard, should be used to launch an Earth satellite as a part of the U.S. program for the 1958 International Geophysical Year explorations.

Directed by the Secretary of the Army to field the Redstone missile as soon as feasible, along with a crash program to develop an Army 1,500-mile (nautical) missile, the Army Ballistic Missile Agency laid aside its hopes for launching an Earth satellite.

Instead, ABMA scientists and engineers concentrated on development of the Jupiter C missile for test flying small-scale versions of heat-protected nose cones for the Jupiter IRBM (Intermediate Range Ballistic Missile).

Jupiter C's first flight, Sept. 29, 1956, carried an instrumented payload on a 682-mile trajectory into space and 3,335 miles down the Atlantic Missile Range to impact in the ocean. To prevent an "accidental" orbit of a satellite, the mission was flown with an inert fourth stage.

When two more successful missions in 1957 established satisfactory proof that the Army had solved the atmosphere reentry heating problem with an ablative nose cone, the remaining Jupiter C missiles were placed in storage.

There they remained until the Oct. 4, 1957 announcement by the Soviet Union that Sputnik I was in orbit. That astounding success was followed Nov. 3 by the launching of a satellite carrying a live dog as part of the experimental package.

In response to rising clamor of the American populace, the Secretary of Defense authorized the Army, on Nov. 8, to proceed with preparations for using the Jupiter C to launch a satellite. Anticipating such approval, General Medaris had ordered on Oct. 5, the day after the Sputnik I announcement, that Jupiter C missile 29 be prepared for the satellite mission.

Cooperatively involved in that task were the ABMA Development Operations Division, which readied the missile for flight, and the Jet Propulsion Laboratory of the California Institute of Technology, which repackaged the instrumentation payload.

Dr. James A. Van Allen of the State University of Iowa, in preparation for the U.S. program for the International Geophysical Year, had designed the experiments for the spherical Vanguard satellite. They had to be refitted into Explorer I's cylindrical shell.

The U.S. hasty first effort to launch a satellite into orbit on Dec. 6, 1957, was a big disappointment. Flying with all three stages live for the first time, Vanguard lost its thrust a split second after takeoff, settled and burst into flames on the launch pad.

Vanguard performed successfully in a later flight but meanwhile, in the rush to succeed, the launch effort had turned to Jupiter C, using an elongated Redstone as the booster with its thrust level increased from 78,000 to 83,000 pounds with a special fuel.

Mounted on top of the Redstone was the "tub," a sheet metal assembly of small solid-fuel rocket motors propelled by the same composition under development for the Army's Sergeant ballistic missile. This second stage consisted of 11 motors and three more formed the third stage. A single motor in the center of the tub was the fourth stage topped by the satellite.

Adverse weather forced Dr. Debus to postpone the launch attempt programed for Explorer I on Jan. 29 until the following day. Then a severe jet stream of 146 knots at 36,000 feet caused another delay after the countdown was started. Marginal conditions of 100-mile- an-hour winds continued on Jan. 31, but General Medaris, in the interest of launch crew morale, gave the order to risk the flight.

The satellite attained orbital velocity at fourth stage burnout. But no one could be sure of success until its radio signal was received by the Jet Propulsion Laboratory's Goldstone tracking station on its first circle of the Earth.

General Medaris was in a press conference at Patrick Air Force Base when the good news came, shortly after midnight, in the form of a handwritten note: "Goldstone has the Bird."

Secretary of the Army Wilbur Brucker called shortly thereafter to congratulate him and to say that he and Army Chief of Staff GEN Maxwell Taylor had selected the name Explorer for the satellite.

In Washington, DC, Dr. Von Braun, JPL Director Dr. William Pickering and Dr. Van Allen joined in a press conference as the good news was flashed across the nation. Spontaneous demonstrations of prideful exuberance spread rapidly throughout the country; the challenge of the Soviets had been met!

Moreover, Explorer I had also achieved its scientific mission, as verified before its usable radio signals ended 63 days later. Instrumentation had detected and given vital data to confirm the Van Allen radiation belts surrounding the Earth—later called by scientists the greatest achievement of the International Geophysical Year.

During the 20 years since that first great wave of America's national exultation over the success of Explorer I, many more fantastic feats have, in some ways, dwarfed that achievement. MAN has incredibly advanced The Conquest of Space—walks and vehicle rides on the moon, flights to Jupiter and Mars, development of The Space Shuttle System.

More than 10 million persons have visited Cape Canaveral, FL, where it all began, since the site of the launching of Explorer I was opened to tourists in 1965. Dr. Kurt Debus, one of many great scientists, engineers and technicians who have contributed immensely to The Space Age, possibly provided the Explorer I capstone.

In writing many years later about the "Goldstone has the Bird" message that was a prelude to many great feats to come, Dr. Debus made one of his typical gross understatements:

"One does not easily forget such a moment."

EXPLORER I Space Age pioneers, shown after 1958 launching, are (standing) Dr. William A. Mrazak and Dr. Walter Haeussermann. Seated, l. to r., are Dr. Ernst Stuhlinger, MG John B. Medaris, Dr. Wernher Von Braun and Dr. Eberhard Rees.